AMERICAN ENGINEER CAR BUILDER AND RAILROAD JOURNAL.

AUGUST, 1897.

CONTENTS.

The Lighting of Isolated Railroad Stations.

The principal disadvantages of separate lamps with glass reservoirs for the lighting of stations are the amount of labor they require in filling and cleaning, their small illuminating power and the liability of disastrous fires resulting from accidental breakage. Even with oil of a high flash-point the danger of conflagration is not entirely avoided. Such small flat-flame lamps usually burn about 0.01 gallons of oil per hour, corresponding to a candle-power of about seven, and an expenditure of 0.06 cents for oil. Now, as the candle-power of ordinary flat-flame gas burners is from 10 to 20, we see that such stations are comparatively poorly lighted by the small lamps. The labor involved is considerable, as the lamps must be filled every alternate day, the wick trimmed and globe cleaned, which consumes nearly half a day in stations using over 30 lamps.

Gasoline plants are expensive to run and liable to explosion when not properly handled. Gas and electricity are not to be considered for isolated stations, as small plants are so very expensive as to be out of the question from economical considerations alone, and as a result railways have been employing separate lamps at their country stations almost exclusively.

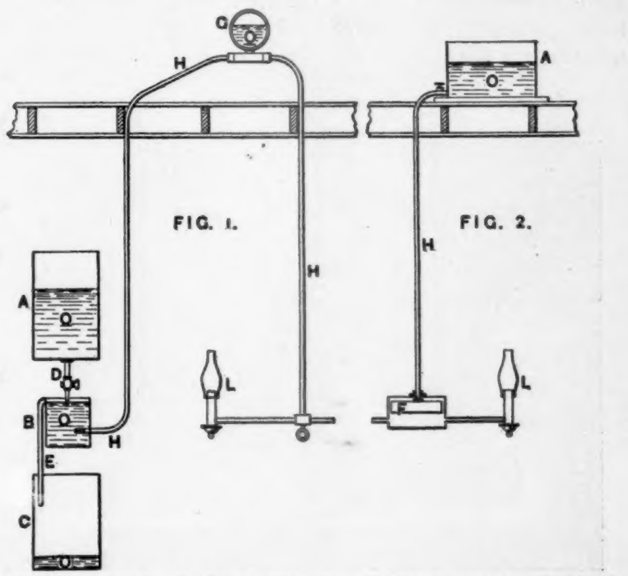
While passing along the line of the New York, New Haven & Hartford Railroad, a system was noticed which seemed new, and through the courtesy of Mr. Wilson, Chief Train Dispatcher, we are able to present some figures of interest to railroad men on a connected-lamp system of oil-lighting. Although this system has been known for probably 15 years, it is not more than four years ago that it received its first application on railroads, and as far as the writer can determine, this road is the only one using such a system at the present time.

The types which have been put on the market may be classified as follows:

I. Reservoir on a level with the lamps.
  a. Underneath system of piping.
  b. Overhead or siphon system of piping.
    1. With siphon air collector.
    2. With pump siphon renewer.
II. Reservoir placed above the lamps.
  a. Flow of oil regulated by valve and float.
  b. " " " " " mercury and float.

A brief review of this classification will lead to a better appreciation of the system in general. The first system is shown in diagram in Fig. 1. The reservoirs are made of galvanized iron, which are carefully soldered and very rarely leak. Reservoir *A* is filled, while inverted, through the opening made by removing the pipe *D*, and is again replaced as shown. *B* is a stationary reservoir having a constant level of oil which enters through *D*, escapes to the lamps through *H* or overflows by *B* into *C*. The top of the oil is about two inches below the level of the top of the wick—all lamps being on the same level. When the level of oil in *B* falls below the end of *D* it permits air to enter *A* through *D* and allows an equivalent quantity of oil to flow out. This automatic arrangement works very well. In underneath piping, the pipes *H* run down to and under the floor and up the sides of the room or post; here there is pressure in the pipes and leakage may occur.

In running the pipes overhead by the siphon system the air tends to enter any orifice in the pipes instead of the oil flowing out, so that there is no trouble from oozing oil. All air tending to break the continuity of flow collects in the highest point of a siphon, and a small reservoir is placed here to catch the air. When nearly filled with air the globe *G* is inverted, which shuts



A, Supply reservoir; *B*, Feed reservoir; *C*, Overflow tank; *D*, Supply nozzle; *E*, Overflow pipe; *F*, Admission float; *G*, Glass bulb air collector; *H*, Oil pipe; *L*, Lamps.

off both branches, the globe screwed off, filled with oil, replaced and returned to position as shown. This must be done once a week.

Another lamp re-establishes a siphon by having parallel pipes, and when the flow ceases, a small plunger pump situated in *B* forces oil through one pipe and back through the other, carrying the troublesome air along with it. The pipe *H* ends at the foot of the chandelier in a spring cone valve. When the chandelier is in position for burning, the stem of this valve is pushed up by the bottom of the T connection, allowing the oil to flow freely; when the chandelier is pulled down, a spring seats the valve and stops the flow of oil. This oil pipe runs inside the chandelier stem and packing is placed between the two. Argand burner lamps with 5-inch circumference wicks complete the outfit. These lamps are usually provided with central draft and have their wicks raised by several methods in common use; drip cups are necessary with all forms. For outside use the underneath system may be employed, as it does away with any attention required by the siphon, although the other is preferable where the possible stains or odor of oil would be objectionable. This system is cleanly and is so much liked that a score of stations on the New Haven road have it in daily operation.

When the reservoir is placed above the lamps, the lamps can be placed on any level below it, which is of considerable advantage, although not a necessity in station lighting. In the previously mentioned class separate reservoirs were necessary for each level, of which there are three, in the case of the outfit at Riverside. When oil is placed under pressure, however, it is difficult to con-

fine it and this is the trouble with this class of distribution. Each lamp or cluster of lamps has its individual reservoir, which contains a float operating a valve, seal, or other device to close the oil supply pipe when this small reservoir is filled to the required height. In Fig. 4 will be seen a device by which the float *F* forces a mask of a certain composition against the end of the fixed supply pipe. This is in use at Greenwich and Stratford stations, and although they furnish a satisfactory light there is sufficient dripping to cause annoyance, and the lamps sometimes are fed too strongly by imperfect action of the valve, causing smoke and excessive consumption of oil. This device is replaced by another firm by a conical valve on a triple seat which is pushed up when the float falls. Such mechanical devices are not satisfactory in general.

Another device, Fig. 6, in the form of a mercury seal is in operation in this country and, as shown in Fig. 5, in England. In both cases as the float *F* falls the head of mercury *H* outside the oil feed pipe *C* falls also. If this head of mercury is so adjusted as to exactly balance the head of the oil from the reservoir above, the oil will flow out of the end of the pipe as soon as the head of mercury becomes less, and will cease flowing when the original level is attained. This valve works well and gives satisfaction, according to the statements of those who use it. The same remarks on oil under pressure hold good here also, and the system is slightly defective, especially as the head above the lamps is not constant while the reservoir is becoming empty.

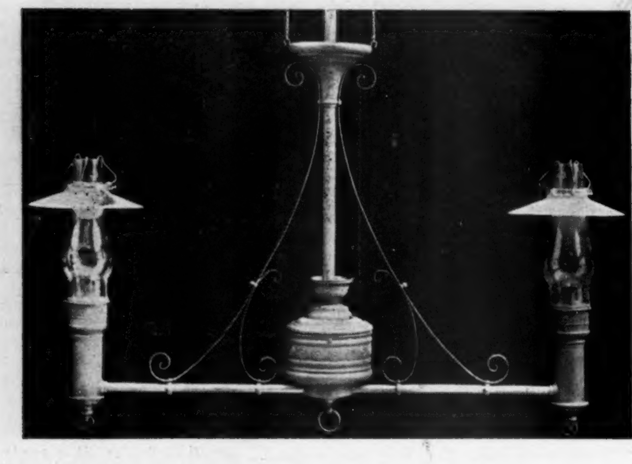


Fig. 3.—Plain Oil Lamp Chandelier.

The class first described has given the best satisfaction, not only in small stations but in more pretentious ones, as at Meriden, where 38 lamps are used, where the price of gas is $1.80 per 1,000 feet, and the railroad preferred to use oil to being imposed upon. At the time the lamps were put in gas was selling at not far from $2.50 per 1,000 cubic feet, and the electric light company controlled both gas and electric lighting. As the consumption of oil at this station is but about 50 barrels per year the siege will probably last some time into the future.

Mr. Julien Lefevre stated before the French Association for the Advancement of Science that 30 grams of kerosene oil were burned per *carcel-heure*, which is equivalent to 0.00135 gallons per candle-power. Professor Jacobus before the Franklin Institute said that his experiments indicated that a 16 candle-power lamp would consume 0.022 gallons of oil per hour, equivalent to 0.00137 gallons per candle per hour. These figures from widely differing sources agree very well, and one could with safety assume the mean, 0.00136, as the basis for calculation. Assume that 0.25 cubic feet of illuminating gas are consumed per candle-power per hour; take the price of gas in small towns at $1.75 per thousand feet, the cost of oil at 8 cents per gallon and incandescent electric light at one cent per hour per 16 candle-power; then we have the following comparison of three methods of lighting stations:

One candle power from	Consumption per hour.	Cost per hour, cent.
Incandescent electric lamps	0.006 horse-power	0.0625
Illuminating gas	0.25 cubic foot	0.04375
Kerosene oil	0.00136 gallon	0.01088

The item of cost must be settled by local conditions. At Wallingford station the oil lighting system displaced gas. The candle-power claimed for these lamps is about 38, corresponding to a consumption of $38 \times 0.00136 = 0.05168$ gallons per lamp hour. The actual quantity of oil burned per lamp hour is difficult to secure as no detail records are kept. Meriden uses 5 to 6 barrels (52 gallons each) in midwinter and three barrels in midsummer; there are 38 lamps, in use of which 11 are outside. Making an approximate calculation of hours burning, the consumption of these lamps is 0.02 gallons per lamp hour.

At Riverside station two barrels of oil are used per month. Of this about 30 gallons are used on switch and tower lights, 16 gallons are burned in seven separate flat-wick glass reservoir lamps

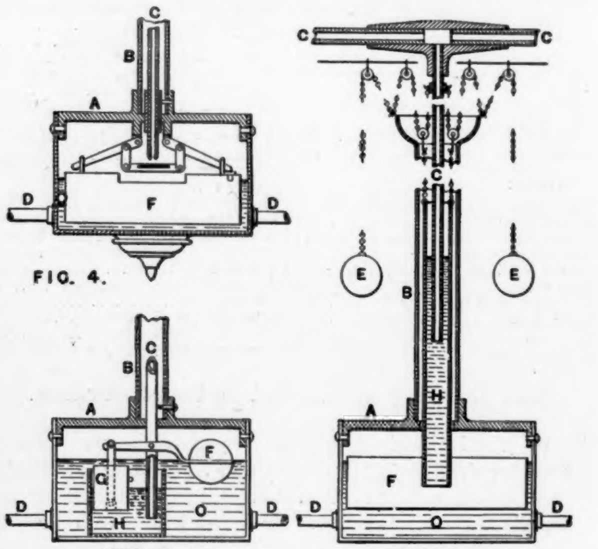


FIG. 4. FIG. 5. FIG. 6.

A, Small reservoir; *B*, Stem of chandelier; *C*, Oil pipe; *D*, Pipe to burners; *E*, Counter weights; *F*, Air-tight floats; *G*, Hollow plunger; *H*, Mercury; *O*, Oil.

(0.01 gallon per lamp hour). Three outside and five inside argand lamps are in constant use, although there is a total of 17 of these lamps at the station, some of which are lit but part of the time. The argand burners connected in the over-head siphon system, consume 58 gallons of oil per month. A close calculation shows that this is equivalent to 0.03 gallons per lamp hour. A store using six lamps reported a consumption which indicated 0.038 gallons per lamp hour used. The manufacturer claims a consumption of 0.042 gallons, corresponding to about 31 candle-power, although he claims 38 candle-power. Another make of lamp at Greenwich consumes relatively one-fifth more oil than those at Riverside station, partly by reason of the reservoir being at a higher level, and also on account of a greater candle-power. Such are the results from practice, which indicate that the candle-power lies between 20 and 30, much greater than any single gas burner usually employed.

The following is the relative consumption and cost of lighting of several stations with oil and gas:

Gas jets.	Number of burners.	Monthly average for the year 1896. Cubic feet.	Gas bill.
Pelham	20	7,100	$10.65
Mamaroneck	11	6,200	10.85
Rye	7	5,200	9.10

Oil argand lamps.	Number of lamps.	Approximate monthly average for year 1896. Barrels.	Oil bill.
Meriden	38	4.5	$18.00
Greenwich	31	4.5	18.00
Riverside	17	1.5	6.00

Even if we assume that the gas jet would give an illumination equivalent to an argand oil lamp and that the same proportion of illumination hours would hold for each lamp and jet, yet the cost of oil compared with that of gas would be in the ratio of 50 to 80 cents per light per month.

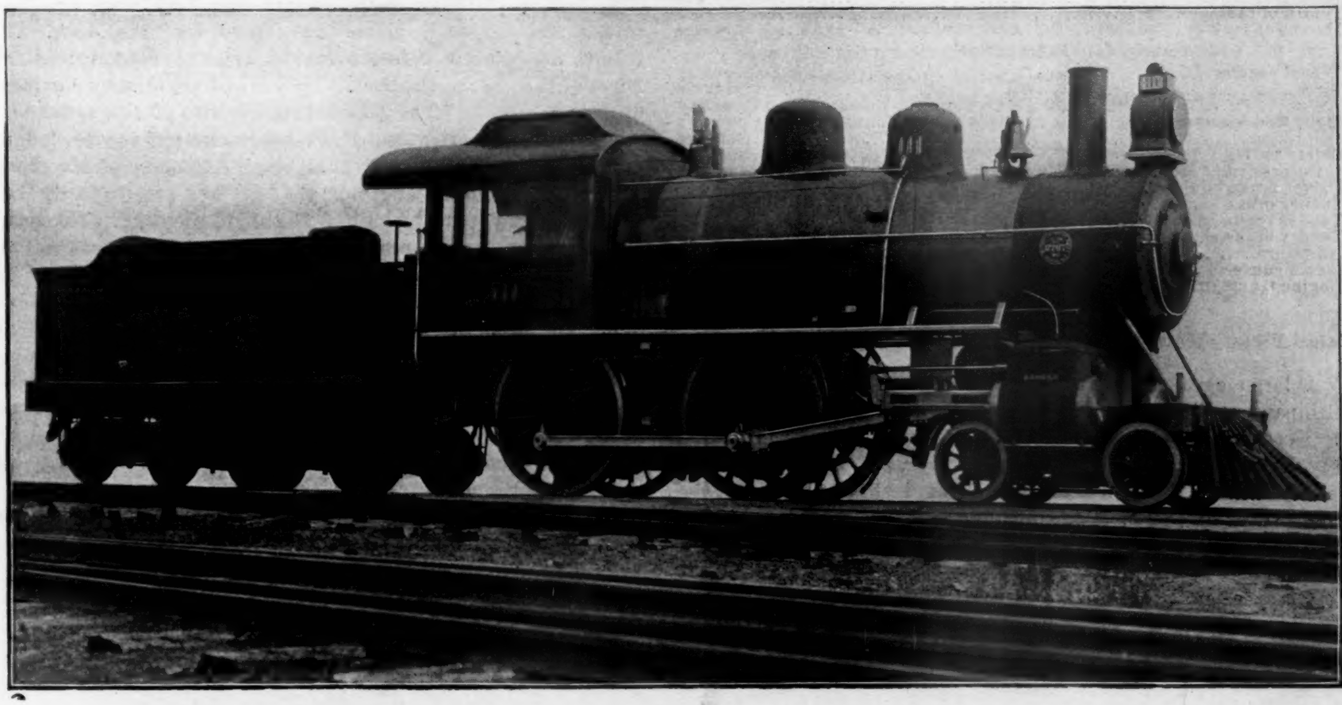
Eight-Wheel Passenger Locomotive—Chicago, Indianapolis & Louisville Railway.

The Chicago, Indianapolis & Louisville Railway, the Monon route, has recently received an eight-wheel passenger locomotive from the Brooks Locomotive Works, the general appearance of which is shown in the accompanying engraving. The more important dimensions of the parts and details of the design are given in the accompanying table, a few of which merit special mention.

The weight on driving wheels is 79,000 pounds, the total weight of the engine being 121,800 pounds and in view of these figures the heating surface is seen to be large, viz. 1,950 square feet. The grate area is 26.8 square feet, which gives a ratio of 72.7 to 1 between the heating surface and grate area. This ratio compares very closely to that of the "Big Four" passenger locomotive of the same type which was illustrated in our issue of January, 1896. The latter has 2,175 square feet of heating surface and 30.75 square feet of grate area, a ratio of 70.07 to 1, but these ratios appear small when contrasted with that of the 10-wheeled compounds of the Northern Pacific, shown in our June number of the current volume, which is 81 to 1. The heating surface of the design under review is large for an eight-wheel engine and gives a further indication of the tendency toward increasing the heating surface to the largest limit possible.

In the construction of the boiler the fewest possible number of sheets have been used, the taper sheet being the first course back of the smoke arch, and which brings the number of courses down to three. The wagon-top is large with this arrangement, and the amount of care given to the boiler seams must be materially reduced. The crown sheet is held by radial stays, no swinging stays being used at the front end. The fire-box slopes downward toward the front, and is placed over the frames, the support for the back end of the boiler being in the form of expansion pads, so arranged as to carry some of the weight to the lower bars of the frames. The whistle and pops are carried on a small dome immediately in front of the cab.

Among the other features of interest in the design are hollow crank pins, brakes upon the truck wheels, arched steam chest covers, light crossheads of the four-bar type, I-beam equalizers hung below the frames and connected to underhung driving springs, and a generally clean appearance of the boiler due to placing the check valves inside the cab. We hope to present some of the details of the locomotive in a future issue. The special attachments and their makers are given in the list appended to the following table of dimensions:



Eight-Wheel Passenger Locomotive—Chicago, Indianapolis & Louisville Railway.
Built by the Brooks Locomotive Works, Dunkirk, N. Y.

GENERAL.	
Gauge	4 feet 8½ inches
Kind of fuel to be used	Bituminous coal
Weight on drivers	79,000 pounds
" " truck wheels	42,800 pounds
" total	121,800 pounds
" tender loaded	88,000 pounds
Wheel base, total, of engine	23 feet 5 inches
" " driving	8 feet 6 inches
" " total (engine and tender)	48 feet 6 inches
Length over all, engine	34 feet 8½ inches
" " " total, engine and tender	58 feet 1½ inches
Height, centre of boiler above rails	8 feet 7½ inches
" of stack above rails	14 feet 11½ inches
Heating surface, firebox	145.6 square feet
" " tubes	1,804.4 square feet
" " total	1 950 square feet
Grate area	26.8 square feet
WHEELS AND JOURNALS.	
Drivers, number	Four
" diameter	72 inches
" material of centers	Cast steel
Truck wheels, diameter	33¼ inches
Journals, driving axle, size	8½ by 11 inches
" truck " "	5½ by 12 inches
Main crank pin, size	6 by 5½ inches
CYLINDERS	
Cylinders	18 by 26 inches
Piston rod, diameter	3½ inches
Main rod, length center to center	7 feet 10 inches
Steam ports, length	17 inches
" " width	1¾ inches
Exhaust ports, length	17 inches
" " width	3 inches
Bridge, width	1¾ inches
VALVES.	
Valves, kind of	Richardson, balanced
" greatest travel	7 inches
" outside lap	1⅛ "
" inside lap or clearance	0 "
" lead in full gear	0 "
BOILER.	
Boiler, type of	Wagon top
" steam pressure	190 pounds
" thickness of material in barrel	⅝ and 11/16 inch
" diameter of barrel	62 inches
Seams, kind of horizontal	Quintuple riveted
" " circumferential	Double "
Thickness of tube sheets	⅝ inch
" " crown sheets	⅜ "
Crown sheet stayed with	Radial stays
Dome, diameter	30 inches
FIREBOX.	
Firebox length	8 feet 1 inch
" width	3 feet 5 inches
" depth front	79 inches
" " back	62 inches
" thickness of sheets	⅜, 7/16 and 9/16 inch
" brick arch?	Yes
" water space, width	Front, 4 inches; sides, 4 inches; back, 4 inches
Grate, kind of	Cast-iron rocking

TUBES.

Tubes, number	300
" material	Charcoal iron
" outside diameter	2 inches
" length over sheets	11 feet 7½ inches

SMOKEBOX.

Smokebox, diameter	65 inches
" length	58 inches

TENDER.

Tank capacity for water	4,000 gallons
Coal capacity	8 tons
Thickness of tank sheets	$\frac{3}{16}$, ¼ and $\frac{5}{16}$ inch
Type of underframe	Wood
Type of truck	Diamond
Truck	With rigid bolster
Type of truck springs	Double elliptic
Diameter of truck wheels	33
Diameter and length of axle journals	4¼ by 8
Distance between centers of journals	5 feet 0 inches
Diameter of wheel fit on axle	5⅜ inches
Type of truck bolster	I beam
Length of tank	19 feet 6 inches
Width of tank	8 feet 8 inches
Height of tank over collar	67 inches

SPECIALTIES.

Wheel centres	Pratt & Letchworth
Tires	Midvale
Axles	Cambria Iron and Steel Company
Sight feed lubricators	Nathan Manufacturing Company
Bell ringer	Gollmar
Safety valves	Consolidated Safety Valve Company
Injectors	"Metropolitan" Hayden & Derby Manufacturing Company
Driver brake equipment	New York Air Brake Company
Tender brake equipment	New York Air Brake Company
Tender brake beams	Sterlingworth Railway Supply Company
Tender brake shoe	Brooks Locomotive Works
Air pump	No. 2 New York Air Brake Company
Steam gages	Ashcroft Manufacturing Company
Engine truck, driving and tender springs	A. French Spring Company

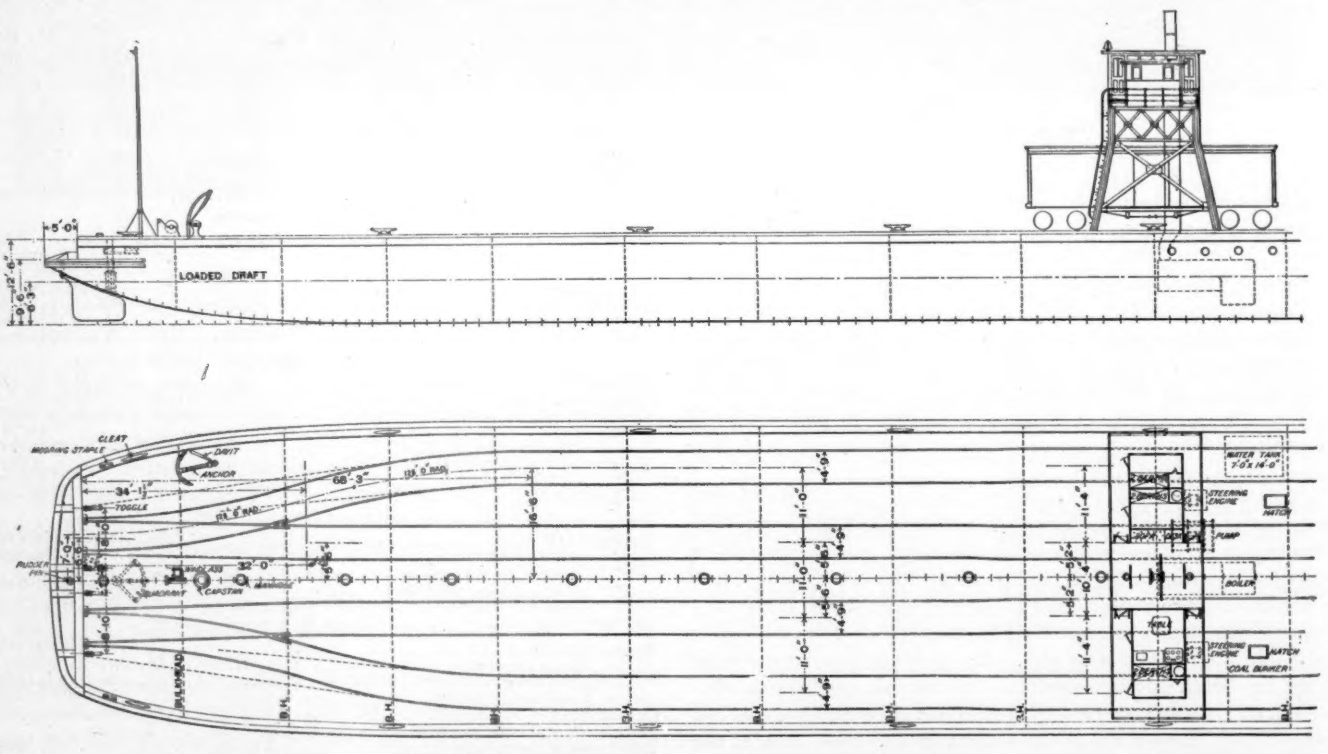
Car Float—New York, Philadelphia & Norfolk Railroad.

A large car float is being built by the Crescent Shipbuilding Company at Elizabethport, N. J., for the New York, Philadelphia & Norfolk Railroad, and through the courtesy of Mr. Theo. N. Ely, Chief of Motive Power of the Pennsylvania Railroad, we are enabled to illustrate and describe it. The float is to be one of the largest ever built and will be known as barge No. 5. It is to be used for the transfer of freight cars between Cape Charles and Norfolk, Va. The length is 340 feet, the beam over all is 47 feet 3 inches, beam over hull 45 feet 4 inches and the total depth 12 feet 6 inches. The draft when light will be 3 feet 8 inches and when loaded 6 feet 3 inches. There are four tracks, which will hold 28 cars, and the equipment and appointments of the boat will be complete and well arranged.

The hull is divided into 18 water-tight compartments by transverse steel bulkheads spaced 20 feet apart. A 6-inch pipe, which runs the entire length of the float, is provided with valves in each compartment for trimming the float with water ballast. The amidship compartment contains the boiler, pumps and steering engines.

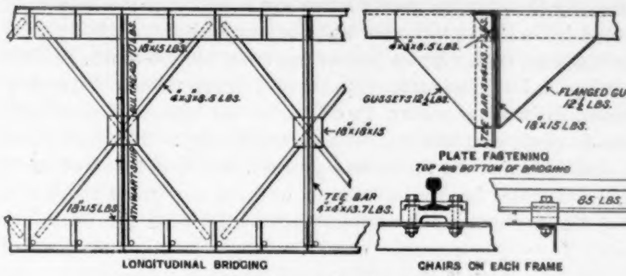
The float is being built to drawings prepared by the railroad company and the details have been admirably worked out. The boat has no shear and the deck plating is flush, the seams being made on joint plates upon the under side. The bottom plating is of the usual form with out and in strakes. The keel plate is $\frac{7}{16}$ inch thick and is 6 feet wide, being straight. The plates in transverse section are straight from the keel plate to the bilge, where they turn on a radius of 4 feet, and the sides from there to the deck are vertical, which is not an unusual construction. The bottom plates on both sides of the keel plate are ⅜ inch thick, and $\frac{5}{16}$-inch plates are used for the deck. The frames are placed 2 feet 6 inches apart at the center and 2 feet at the ends of the boat. They are of angles 4 by 3 inches of 8½ pounds section. The deck beams are also of the same sized angles and they are gusseted to the frames and to the longitudinal bracing. This longitudinal bracing consists of six trusses which run the entire length of the boat and are virtually keelsons extending from the bottom plating to the deck. The chords of the trusses are 15-pound plates, 18 inches wide, and the bracing between them is made of 4 by 3 inch 8½-pound angles. The verticals or struts are T-sections, 4 by 4 inches of 8½ pounds section. The struts are omitted at the bulkheads and two 4 by 3 inch angles with the $\frac{5}{16}$-inch bulkhead plate between them are substituted therefor. The bulkhead plates are joined to the bottom plating by 3 by 3 inch double angles and gusset plates are used in the deck connections. The truss plates are continuous and gussets are used at each frame. The keel plate is braced by vertical transverse plates to which the frames are riveted.

The deckhouse is carried on a large bridge supported by four posts of channels which have ample gusset bracing at the deck and bridge. In the deckhouse are the pilot-house and cabins for the crew. The float has two rudders, one at each end, which may be worked by two independent Williamson steam steerers or by independent hand gear. The rudders are made on spider frames and have no bottom support. All of the machinery is located in the compartment under the bridge. Steam is supplied by a small Scotch boiler 5 feet 6 inches in diameter by 7 feet long,



Car Float, New York, Philadelphia & Norfolk Railroad—Crescent Shipbuilding Company, Builders.

and 3,500 gallons of fresh water may be carried in a cylindrical tank in this compartment. The pump for trimming the float and for fire purposes is of the Snow duplex pattern, with 8½ by 10 inch cylinders. The 6-inch pipe already referred to connects this pump with all of the compartments, and communication either for emptying or filling them may be made by a valve controlled by a hand-wheel at the deck over each compartment. A



Car Float—Longitudinal Bracing.

Providence brake windlass and a Providence hand-power capstan are provided at each end of the float.

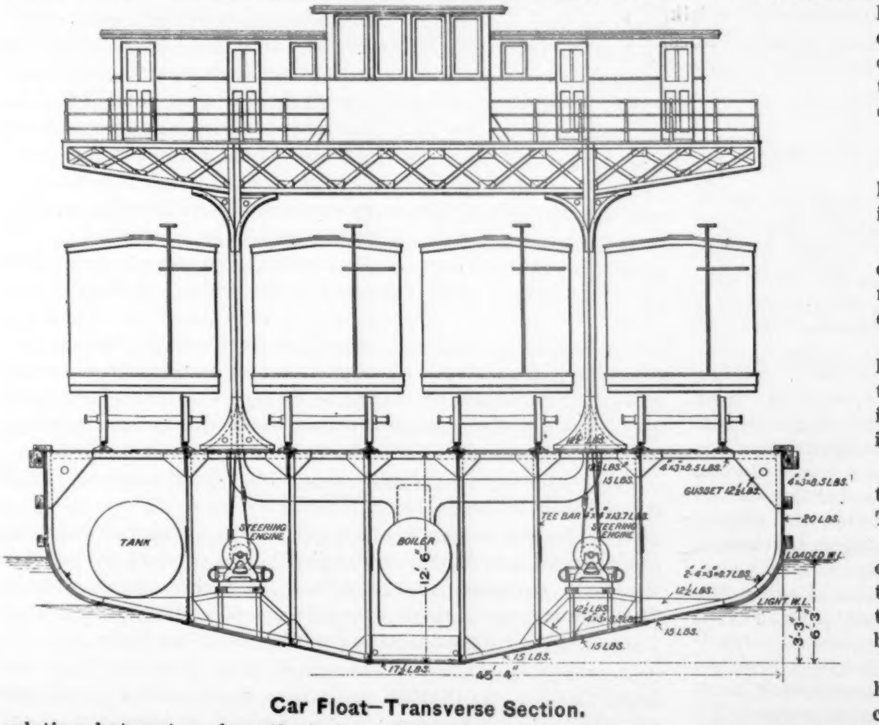
The courtesy of Mr. Lewis Nixon, of the Crescent Shipbuilding Company, and of Mr. Theo. N. Ely and Mr. H. S. Hayward, of the Pennsylvania Railroad, are acknowledged.

Heating Apparatus, Belgian Grand Central Railway.*

BY E. BELLEROCHE.

In the Minutes of the Proceedings of the St. Petersburg Meeting of the International Railway Congress there is a description of the system of heating passenger trains which was examined and adopted by the Belgian Grand Central Railway.

It will be remembered that the system consists essentially of circulating hot water along the train and back again, starting from and returning to the engine.



Car Float—Transverse Section.

The circuit consists of two parallel pipes all along the train which are fixed in the floors of the carriages, one being for the flow, and the other for the return; they are connected on the last carriage by a tail pipe which turns the current back into the return pipe.

A range of radiators is connected centrally and perpendicularly to each of the pipes, and lies in the same plane as the pipes.

Each carriage therefore contains two sets of radiators supplied one by the outward pipe and the other by the return pipe.

In this way, a uniform temperature of the heating surfaces in all the carriages is obtained from end to end of the train, the temperature being equal to the mean of the temperatures of the radiators.

The current of water taken from the tender is heated, and caused to circulate either by a small donkey pump and a jet of steam, which heats the outflowing water to any desired temperature, or else by means of a special injector, the temperature of the outflowing water being raised if necessary by means of a steam jet.

The engine driver also controls the temperature in the train by the indications of thermometers placed at each end of the circuit. He regulates the speed of the flow by the indications of a pressure gage. He can thus always regulate the amount of heat sent into the train according to circumstances.

This arrangement puts in the driver's hands the power of controlling between the widest possible limits the amount of heat sent out, and of proportioning it to the number of carriages, and to the external temperature, by regulating the delivery of the pump, and the amount of steam, which determines the temperature of the outflowing water.

It makes the boiler feed independent of the train heating, and the train heating independent of the caprices of injectors.

It was on account of secondary considerations that this plan was not adopted.

The locomotive appliances which have been fitted to most of the engines on the Belgian Grand Central Railway consist essentially of a special heating injector, the starting point of the outflowing current which is fed with cold water from the tender. The water after passing round the train is collected in a special reservoir in the tender, the end of the return circuit, and this water, which has a temperature of 50 degrees to 65 degrees C., is used to feed the boiler.

The delivery of a No. 5 injector is sufficient to heat a train of the maximum length in regular use. One of the feed injectors is connected to the outflow pipe to help to start the heating.

The apparatus to which we refer, though simplified, is still too complicated to apply to existing stock.

This combination gives the driver the following means for regulating the amount of heat sent out: the variation of the steam jet which heats the water as it comes from the heating injector; the stopping of the heating injector and the use, as arranged, of the feed injector.

It necessitates the use of pumps for feeding the boiler, or else of special injectors adapted for high temperatures, which means that the existing injectors must be taken out.

This method was abandoned on account of its complication and the failure of all the experimental arrangements made since the beginning of our trials, in order to try the following system.

The water after passing round the train is delivered straight to the heating injector, which thus connects together the two ends of the heating circuit. The total supply of water to this injector consists of two parts:

1. The quantity of water required for heating the train and furnished by the return current. This quantity is again sent out to the train;

2. A quantity supplied from the tender, sufficient to lower the temperature of the mixture to an extent determined by the necessities of the heating. This quantity is delivered to the boiler.

The use of a No. 7 injector insures sufficient heating powers for the largest trains in the coldest weather.

The return current to the tender is subject to variations of speed caused by the presence of air remaining imprisoned in the pipes, and also by the impulses due to the inertia of the water when the train is stopping and starting; owing to these irregularities it is wise to use a restarting type of injector for the heating injector.

The apparatus by which we solved the problem this winter is extremely simple.

The heating injector is fitted with a branch which turns the balance of the supply, not used for heating, into the boiler.

The mixture takes place before they reach the injector at the point where the cold water from the tender enters the circuit; an intimate mixture is insured by the division of the current of hot water into fine jets by means of the small holes in the end of the pipe

---

* From a paper published in the Bulletin of the International Railway Congress.

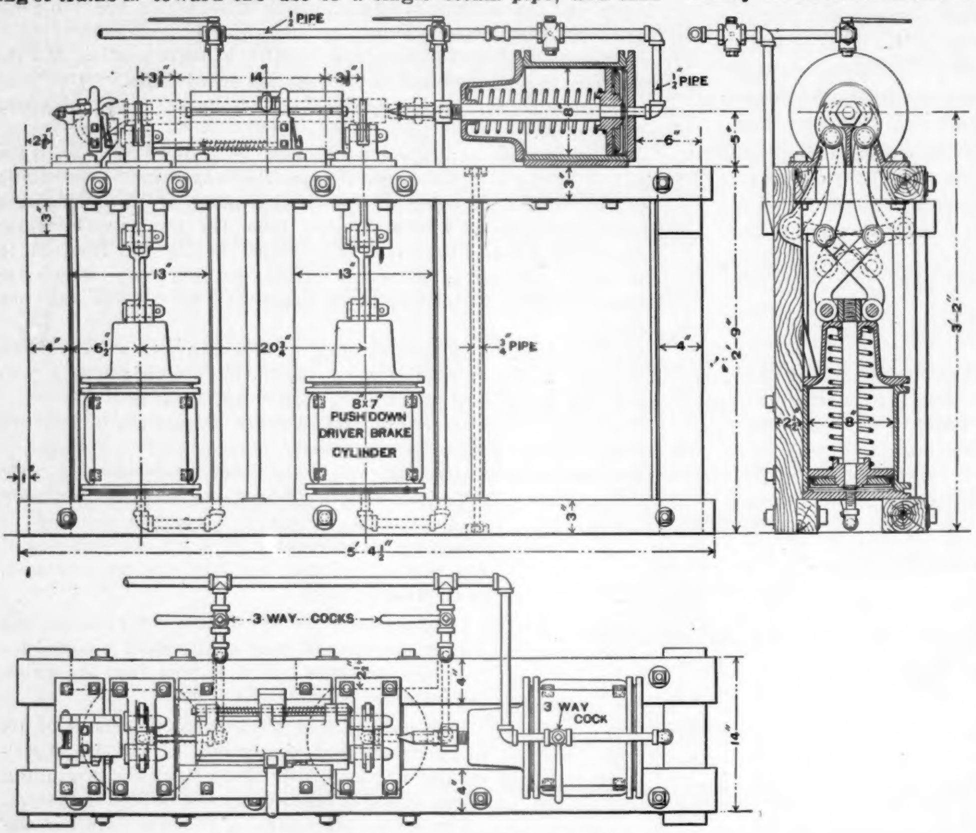
through which it flows; these jets strike against vanes arranged in a ring, which are in constant vibration owing to being suspended on the end of a spring.

This apparatus is completed as in the former arrangement by a connection on the delivery pipe of the injector to one of the boiler-feed injectors which is used as a help at starting.

The driver can regulate the amount of heat sent out by the following means: By varying the amount of water delivered to the train, by varying the amount of steam used in the extra steam jet which further heats the water after leaving the injector, or by shutting off this jet altogether.

This system requires that the boiler should be fed continuously; the gradients on the line and the shortness of the train may require the heating injector to be stopped for short intervals, which means that the heating is also stopped. These difficulties confuse the drivers at first, but they get used to them.

There is no doubt that the tendency of modern ideas on the heating of trains is toward the use of a single steam pipe, and that



Machine for Mounting Air Hose.

steam heating has recently been much improved, and that these circumstances will prejudice the extension of the Belgian Grand Central system.

It is nevertheless incontestable that this system presents great economic advantages over steam-heating systems, and that in our climate if the public were asked to decide between the Belgian Grand Central heating and the direct steam heating on the German lines they would not hesitate an instant.

We therefore expect that time and the approval of passengers will prove that the use of a double water pipe is the solution of the question of train heating in our climate.

Practice has already proved the apparatus. The only improvements which we think ought to be made in new applications are to decrease the diameter of the pipes, and to increase the size of the emptying cocks, and to modify the coupling of the flexible pipes which connect the carriages.

The Belgian Grand Central radiators can be connected so as to work full or empty as appartus for steam heating, in international trains, by connecting them with the steam pipe of the latter.

At the same time the present tendency is to use carriages of special types for the international traffic.

The only serious trouble in the Belgian Grand Central system is the emptying—a question of organization.

No system, continuous or not, is free from such difficulties. Steam heating has also its continuous drains, and we have more confidence in the employment of responsible agents than in the action of automatic apparatus.

Machine for Mounting Air-Hose.

BY OSCAR ANTZ.

The extensive introduction of air-brakes on freight cars has made the maintenance of the hose connection a matter of considerable importance. When a hose is removed from a car on account of being unsafe, or perhaps burst, the coupling and nipple are usually found to be good for use again, and it is the custom of most roads to-day to buy new hose in proper lengths and put in the couplings and nipples, either new or second-hand, in their own shops. This mounting of the hose is sometimes done entirely by hand, the fittings being forced into the hose and the clamps screwed up without the use of any machinery. This has, however, been found to be too slow a process, and machines of more or less elaborate design have been devised for doing the work, nearly all of which make use of compressed air for the necessary power. Most of the machines of this kind which have been described in the technical papers require several changes of the position of the hose from one place to another before the work is complete, which entails considerable loss of time, and it was for the purpose of doing all the operations without changing the position of the hose that the machine herewith illustrated was designed. Similar machines have been in use in a number of shops for several years, and the pieces of hose are mounted by two workmen, complete and ready for testing, in about half a minute for each hose.

The machine, of which the drawings show the general arrangement, consists of a framework of wood, strongly bolted together, on which are fastened three cylinders, the pistons of which are operated by compressed air, one for forcing the fittings into the hose and the other two for putting on the clamps. The cylinders shown are the regular Westinghouse 8 by 7 inch push down driver brake cylinders as employed on locomotives. These are usually kept on hand in railroad shops; they are perhaps somewhat larger in diameter than is necessary, but as they can probably be obtained in most shops much more readily than new cylinders of smaller size can be made, they are shown here.

On top of the frame near the center, is located a sliding vise in which the hose is held, this vise being forced to the right by a spring; the hose is placed in this vise with equal parts projecting at either end, and is held in place by the cover which is hinged to the lower part and is thrown back by springs when released. The coupling is held in another vise, placed on the left end of the frame and is made so as to hold either one of the three styles of hose couplings which are at present in use. The couplings are held in such a way that the part which enters the hose is horizontal. The cylinder is placed on the right end of the frame, and the piston rod is provided, instead of a cross-head, with a nut having a round end over which the nipple is placed.

To mount a hose, the coupling, nipple and a piece of hose are placed in the machine as stated and as shown by dotted lines, and a small amount of thin rubber cement is smeared on the parts which enter the hose and also on the inside of the ends of the hose. When pressure is applied in the cylinder, the piston forces the nipple into the hose and the latter being free to slide with the vise in which it is held, forces itself over the end of the coupling. When mounted, the covers of the two vises are released and the hose can be moved slightly if necessary to bring it in the

right position for putting on the clamps. This slight adjustment is found necessary sometimes on account of variations in the lengths of the different pieces of hose. The apparatus for putting on the hose clamps consists for each end of the hose of a vertical cylinder, to the cross-head of which are attached a combination of four levers, arranged in such a way that with an upward motion of the piston the upper ends of the upper levers are forced toward each other in almost a horizontal direction. The lugs on the back of the hose clamp are placed against the steel points of these ends and on the application of pressure, the clamps, which are placed on the hose before the fittings are put in, are forced around the hose, bringing the lugs for the bolts close together, when the latter can be put in and the nuts screwed up with but little help of a wrench.

The principal parts of this machine are shown in detail and do not require any further explanation. The pins used in the connections of the clamping device are the M. C. B. standard air-brake pins and the three-way cocks can be made of the regular half-inch Westinghouse cut-out cocks by filling in where necessary with babbitt or solder, although better results are obtained by making new castings for the chamber and plug.

The "Compo" Brake Shoe.

The exhibit of brake shoes by the Composite Brake Shoe Company, at the recent Master Mechanics' and Master Car Builder's conventions attracted considerable attention and comment. The shoes were shown in various stages of wear from new unworn shoes to those which had seen 20,000 miles of service. The principal object of this shoe is to introduce into that section of a brake shoe which comes in contact with the wheel where the rails wears it, a softer material that will have a high braking efficiency, and still not wear away the wheel. This type of brake shoes is of special interest because of the employment of sections of cork which are secured in recesses in the face of the shoes by means of dovetailing assisted by compression of the corks. When heated by the friction of the shoes upon the wheels, the corks have a tendency to expand, which assists further in holding them firmly in position. This is not the first application of wood in this connection, as will be seen by an examination of the report of the 1895 convention of the Master Car Builders' Association, but in the earlier experiments the wood gave trouble from shrinking and loosening in the shoes, though the friction obtained was high.

This difficulty appears to have been entirely overcome by the use of cork, and increased frictional qualities are obtained without the shrinking and loosening. It is stated that the experience with these shoes has shown no case of the corks working loose, that the tire-dressing properties of the shoes are excellent and that there is no tendency to cut or groove the tires. A claim that is strongly urged for the cork shoe is that the elasticity of the plugs acts in such a way as to avoid the gripping and setting of shoes, which tends to lock the wheels and cause sliding. The manufacturer aims to produce a brake shoe with the retarding features of soft cast iron and with the wearing qualities of hard cast iron. Furthermore, they say if shoes can be used that are composed partly of chilled and partly of soft iron, shoes having cork inserts can be made wholly of chilled iron which will give a maximum of braking and mileage results with a minimum of wear on the wheel.

The exhibit referred to consisted of six shoes which had seen service and two new ones never used. One of the worn shoes ran 57 days on a locomotive driving-wheel and made 11,970 miles between Aug. 8 and Oct. 3, 1896, with 100 service stops per day. The corks and the face of the shoe were both in excellent condition, the shoe being only partially worn out. Another driving wheel shoe had been used 50 days and made 10,500 miles, A similar shoe to that first mentioned had made 20,160 miles, and a tender shoe which had made 6,268 miles and 5,382 stops appeared to be good for a large additional amount of service. The remaining example was a driving-wheel shoe, the corks of which were nearly worn out by a service of 101 days, the mileage being 21,210 and the number of stops being over five thousand. These records must be considered as entitling this form of brake shoe to careful consideration. The claims for it are strong and they appear to be justified. Mr. W. W. Whitcomb is President and General Manager of the company, with office at 620 Atlantic avenue, Boston, Mass.

The Future of Fuel Gas.

The supply of fuel gas in cities for household use and for the generation of power is a question which is being discussed by the gas companies with a good deal of interest. At the recent meeting of the Western Association this subject was brought up, and the opinion was generally expressed that the chief prospect for extension of the business was in this direction. What can be done with fuel gas is shown by the experience of Pittsburgh and other cities with natural gas, and the supply of fuel gas in the city of Bridgeport in Connecticut is understood to be working well. The experiment of the Dominion Coal Company, at Halifax, in Nova Scotia, where the gas is obtained from by-product coke ovens, will be closely watched; it is said to be so far successful that the company is arranging its plans for the full installation of the larger plant to supply Boston and the adjoining cities.

We believe, as we have heretofore said on many occasions, that the ultimate solution of the question should be in the establishment of great plants at the mines. where the coal could be converted into gas, and from which it would be piped to the cities. A plan of this kind is said to be under consideration in Pittsburgh, and an investigation of the cost of producing power under different circumstances is being made for that purpose. It is said that the parties concerned believe that with the cheap and abundant supplies of coal accessible, the use of the best plant, and careful attention to the saving of by-products, power can be supplied from the Pennsylvania and West Virginia mines at quite as low a cost as it is obtained at Niagara Falls. It is to be hoped that the experiment will be tried.—*Engineering and Mining Journal.*

American Electric Railroad System in London.

The latest addition to the system of underground railways in London will probably rank as the most important of all these lines before it has been very long in operation. It will be known as the Central London Railway, and, starting from the busy Liverpool Street Station in the city, it will run by way of Holborn and Oxford street, along the Northern side of Hyde Park to Shepherd's Bush, a distance of six miles and a half through the busiest part of London. The road will be about 65 feet below street level, and will be carried in two separate and parallel tunnels—a similar plan to that adopted in the Southwark underground railway in the same city. Each station will be served by two elevators and two stairways.

The new undertaking has special interest for Americans, from the fact that the electrical equipment of the road itself and of the extensive system of elevators by which it will be served will be furnished by American firms.

The third rail equipment will be put in by the English representatives of the General Electric Company—the British Thomson-Houston Company. It will be similar in its general outlines to that which was employed by the General Electric Company on the New York, New Haven & Hartford Railroad.

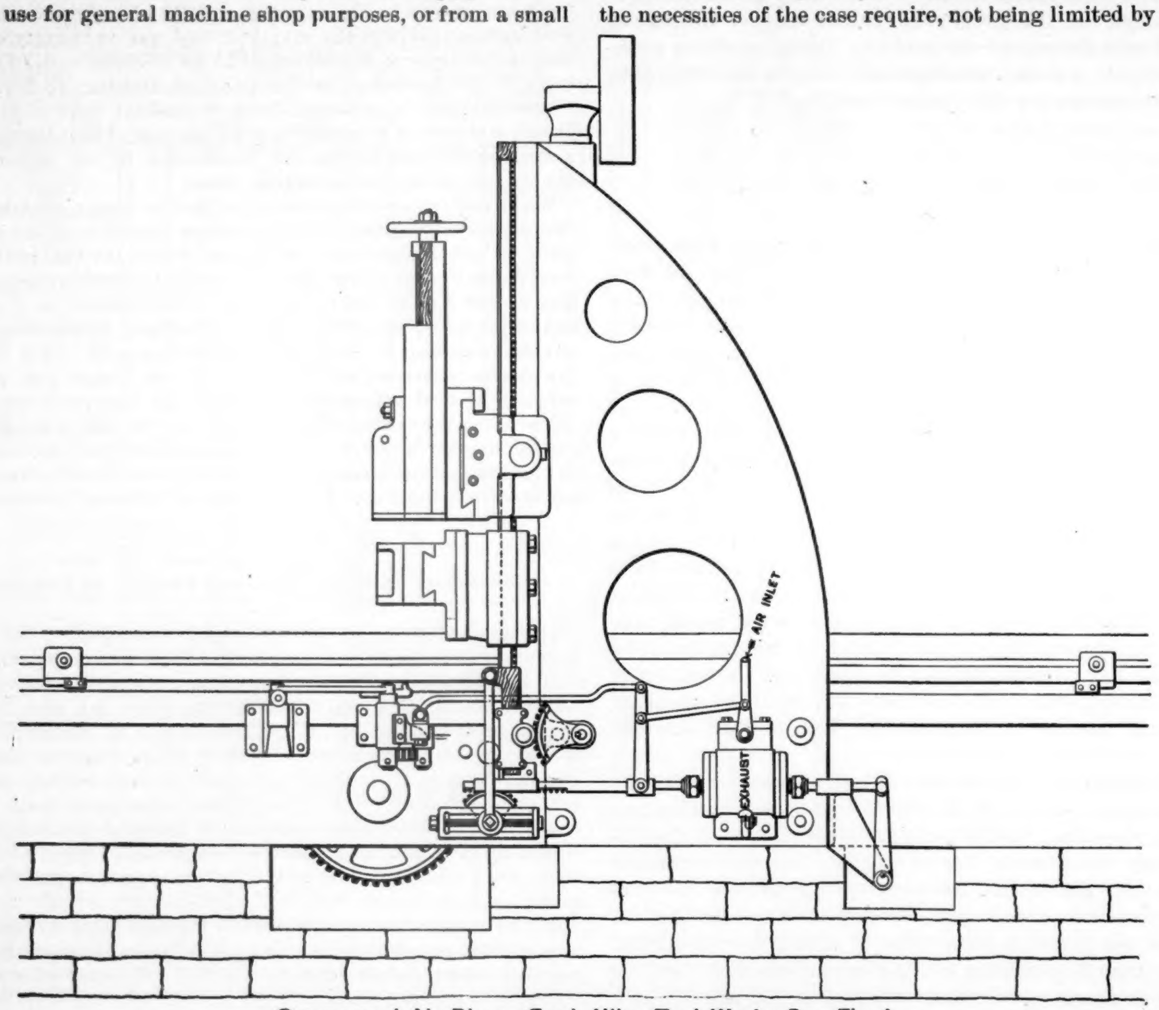
The conductor will consist of an insulated third rail, placed on the ties betwen the main rails. The system will differ from that on the New Haven road, however, in that the trains will be hauled by separate electric locomotives, whose general appearance will conform to the well-known heavy locomotives which are used in the belt line tunnel at Baltimore. On the New Haven line, it will be remembered, the motor cars have accommodations for passengers. The change is made to accommodate the reduced clearance of the tunnels. Equally interesting will be the extensive elevator equipment. There will be 49 elevators in all, and they will be of the well-known double drum Sprague type. Their capacity will be 100 passengers per trip, or a load of about 15,000 pounds. This constitutes a marked triumph of our electrical engineers, and it is no small compliment that such equipment is to be used in London.

Compressed Air in Machine Tool Operation.

An application of compressed air to the operation of planing machines, which will be of great advantage to that type of machines and add greatly to their efficiency, has been recently patented by Mr. Alexander Gordon, President of the Niles Tool Works Company.

A wholly reliable and positive feed has long been desired and never has been fully attained. In Mr. Gordon's device the feed is actuated by air, and is stated to be absolutely positive and reliable, and practically unlimited in range. A quicker return than ordinarily obtained is desirable. By the operation of clutch-pulleys by air any desired speed may be obtained, and the mechanism is exceedingly simple, with but few parts and none subjected to excessive wear.

We illustrate herewith the patented pneumatic feed and quick return. The air is taken from the compressed air supply such as is now in use for general machine shop purposes, or from a small pump that may be attached to the machine in any convenient position and driven by a belt from the countershaft. It is carried from the pump or compressor through suitable pipes to the air cylinder that controls the feed and driving-clutch mechanism. A specially constructed valve admits it to the cylinder. This valve is operated through simple connections, fully shown, by the shifter arm and reversing tappets on the planer table. When the the table carries the tappet or dog against the reversing lever, instead of shifting the belts, as in the ordinary planer, it moves the valve-lever controlling the air admission to the cylinder. This instantly throws the piston in the cylinder to the opposite end, and carrying the rack to which it is attached forward or backward to operate the feed-rack. At the same moment the clutch operating the worm-shaft is thrown over, and the direction of the table-motion is reversed. This shifting arrangement is extremely simple and most efficient.



Compressed Air Planer Feed—Niles Tool Works Co.—Fig. 1.

By examining the engravings it will be noticed that the piston rod is carried through the cylinder toward the back of the planer and is connected to a lever. The opposite end of this lever is attached to a rod running across and under the bed to the worm-shaft. On the worm-shaft end of this rod is a segment gear, whose teeth work into a short rack. The rack is attached to a rod, which moves the central member of the clutch from one pulley to the other, and the pulleys are operated one by a straight and one by a cross-belt. It will easily be seen how the reverse motion is obtained.

Figure 2 shows the clutch pulleys, bearings, sleeves and casing in section, exposing the clutch shifter rod in the interior of the worm shaft and clearly shows the various features of these parts.

The belts run continuously in one direction, thus preventing the excessive wear due to shifting, that due to overcoming momentum of pulleys and other parts, and to the rubbing of the edges of the belt in the shifter-eyes. The belts can be made as wide as the necessities of the case require, not being limited by any of the conditions always prevailing in other planers. The clutch, from its peculiar construction, holds most tenaciously under very slight pressure and is quite easily released.

No adjustment is required in keeping the clutches in working order, as it has been shown that they will perform their duty until the wood facing is entirely gone, and the replacing of this facing or lining will not cost nearly as much as the repairs to and replacing of belts. This is believed to be an ideal machine for variable speeds, as the pulleys controlling the cutting speed can easily be made in the form of cones, and the belt may be shifted as on a lathe. The pulleys operating the return stroke could also be made in this manner, and the speed increased or decreased as the piece being planed was very heavy or very light.

We would sum up the peculiar merits claimed as follows:

Instantaneous, positive and maximum feeds.

Quick return, 6 or 8 to 1, with air cushion preventing shock.

Economy in operation and power required.

No shifting of belts, and, hence, freedom from such wear.

Variable speeds without the use of special appliances.

Simplicity in design, involving no complicated mechanism, nor necessitating other than the ordinary provision made for any other planer.

A number of these planers, from 32 by 32 inches to 10 by 10 feet, are in successful operation at The Niles Tool Works, and a 54-inch planer, for planing locomotive frames, with 35 feet traverse of table, is now under construction. The quick return on this planer is especially desirable by reason of its length and the comparatively slow speed of the cut.

Railroad Engineering at the University of Minnesota.

The demand for education in railroad subjects is being provided for by a number of the progressive technical schools and among them the University of Minnesota offers a special opportunity for studying in this line. The railroad department is under the direction of Prof. H. Wade Hibbard, who has had an extensive practical experience as a preparation for it. We have received a complete announcement of the various courses of the university and present the statement having special reference to the railroad field as follows:

Railway Mechanical Engineering.—A complete senior year is arranged for students wishing to specialize in this subject. The various courses may, however, be elected separately, subject to the requirements for previous preparation, to fill out the electives in the regular senior year of any department.

Students are encouraged to work, under special arrangements, in railroad shops during the summer vacations. This has proved its value as preparatory to the special work of the senior year. In every possible way the methods of the department are intended to place the student thoroughly in touch with the best railroad work; keeping always in sight the limitations to strict theory which railroad experience has found financially and practically to exist.

The location of the university is particularly favorable, being between the cities of St. Paul and Minneapolis, in proximity to the shops, yards and headquarters of the extensive railway systems of the Northwest, with which the department is in closest touch. The Northweast Railway Club, meeting monthly for papers and discussions, is open for the attendance of students, while several are enrolled as members. Instruction upon the air-brake was given for 1897 in the special air-brake instruction car of the Great Northern Railway by Mr. M. E. McKee, Superintendent of Airbrake.

In locomotive testing valuable experience was gained during last year by road tests of two simple and three compound locomotives. These were complete tests of boiler and of engine, with dynamometer car, following the standard directions of the Master Mechanics' Association. Half the tests were made under usual working conditions, and half with a second locomotive and expert braking crew behind the dynamometer car so that the test locomotive ran at constant power and speed up and down all grades.

Students have frequent reference to a personal collection of over 1,500 blue-prints and drawings, carefully catalogued for easy access, from the leading railroads and locomotive builders of the country and the number is continually increasing, As these date from 1867 to the present, they well illustrate the past progress in railway and shop equipment, as also the present "state of the art." There are also complete files of the Proceedings of the American Railway Master Mechanics' Association and the Master Car Builders' Association.

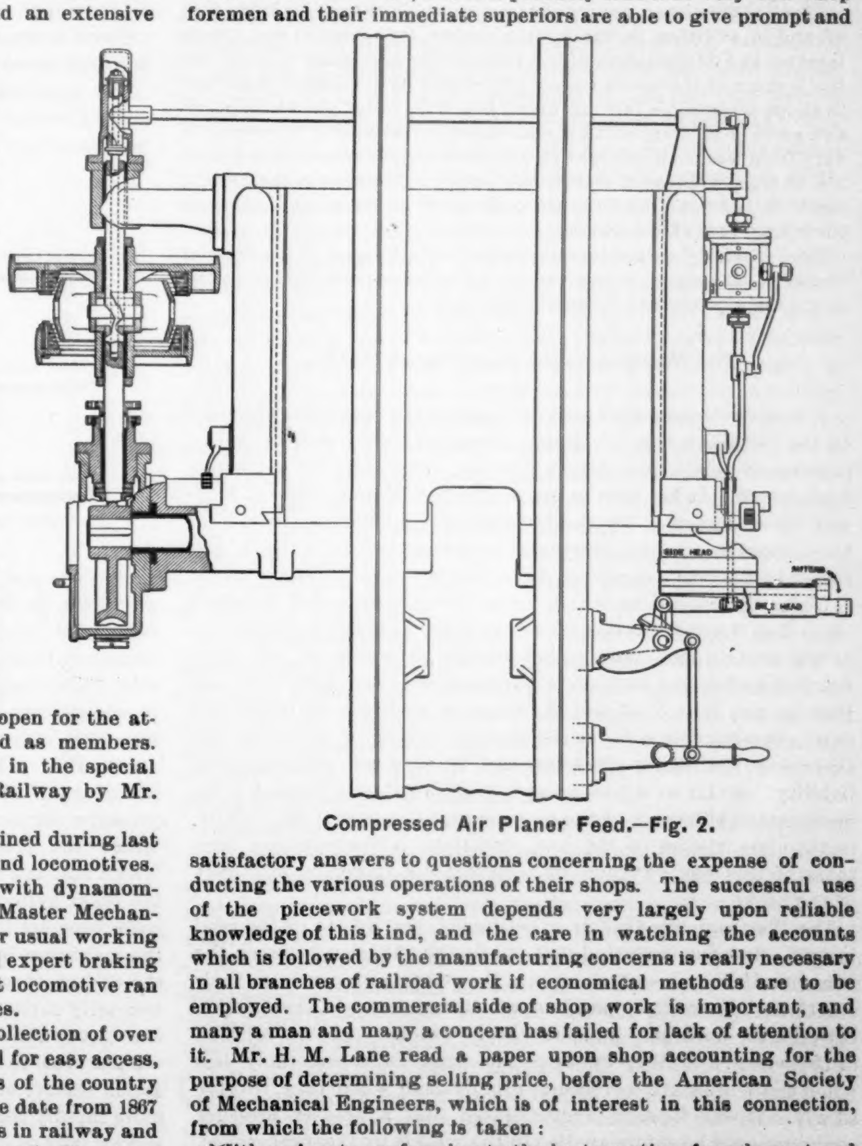
The Library of the department contains a collection of historic and recent works, the best standard books being purchased as soon as issued. There are a number of complete files of the transactions of engineering socities and of the leading technical publications. The reading-room is amply supplied with both the general mechanical and railway press.

Journal Club.—This is conducted through the year for the reading and discussion of the current engineering literature and the student is instructed in the making of a "card index" of the subjects and references. The continued growth and use of this method of preserving information in a readily accessible form has been found exceedingly valuable in school and later professional work. The training in easy, clear and concise speaking, by describing machines or processes of railway and general mechanical engineering, afforded by the club, is also beyond value for the future advancement of the technical graduate.

Visits of Inspection.—During the year numerous visits are made to the manufacturing plants of St. Paul and Minneapolis, which have proven to be of great value in supplementing the class-room work.

A Much Neglected Item of Shop Management.

The starting point in comparisons and estimates concerning work which is to be done in manufacturing shops is the cost of doing it. The railroads are not manufacturing to sell, but it is scarcely less important for the actual cost of production to be known for that reason, and it is probably true that very few shop foremen and their immediate superiors are able to give prompt and



Compressed Air Planer Feed.—Fig. 2.

satisfactory answers to questions concerning the expense of conducting the various operations of their shops. The successful use of the piecework system depends very largely upon reliable knowledge of this kind, and the care in watching the accounts which is followed by the manufacturing concerns is really necessary in all branches of railroad work if economical methods are to be employed. The commercial side of shop work is important, and many a man and many a concern has failed for lack of attention to it. Mr. H. M. Lane read a paper upon shop accounting for the purpose of determining selling price, before the American Society of Mechanical Engineers, which is of interest in this connection, from which the following is taken:

With a view to conforming to the best practice of our largest and best shops in their methods of handling the details entering into the estimates and statements, information was asked from, and cheerfully furnished by, the heads of about 40 concerns in different branches of the machine business in widely separated localities. By one it was suggested that this is a commercial and not an engineering question. But as a mechanical engineer without the commercial instinct would be unable to earn enough to pay his dues in this society, it is assumed that all members in good and regular standing possess that instinct and consider the subject germane to the objects of our organization. It is gratifying to note that as a rule the larger and more prosperous the concern

the greater the interest in the subject and the fuller the answers to inquiries as to their methods. One manufacturer relates that he can never reconcile the profit on any or all articles manufactured by his company as figured by their method and their bank account at the end of the year. Another incidentally proves in stating his method (?) that small work cannot be as cheaply produced in a large as in a small shop even when the general expense is already met by the large work. Another remarks as to determining selling price: "Oh, we let the other fellow do that." Subsequent inquiry, however, showed an accurate knowledge of the difference between the shop cost of the correspondent's goods and the "other fellow's price."

The following method is obtained by selecting and re-grouping from the best practice those features which seem most desirable. Shop cost is the sum of—

1. Producer's labor.
2. Cost of material, including freight, hauling and waste.
3. Plant charge.
4. Burden.

The items, producer's labor and cost of material require no explanation.

Plant charge is an hourly charge for machine tools independent of, and in addition to, the hourly charge for operator, and covers interest and depreciation of the value of the particular tool and the tool's share of the entire cost of power and power distribution, and in shops using tools varying greatly in size, value, power required and amount of transmitting, machinery involved will be found to vary from less than one cent to over 40 cents per hour. This hourly tool charge, when once established, is not likely to vary materially, and it is listed and used by the cost clerk in the same manner as the hourly rate of a workman.

The "burden," an appropriate term met with only in the reply of Fraser & Chalmers, is the sum of all expenses chargeable to the shop except producer's labor and material.

The Westinghouse High-Speed Brake.

A new development of air-brake apparatus has been perfected by the Westinghouse Air Brake Company, for the purpose of improving facilities for stopping trains which run at extremely high speeds. It has been in use on the New York Central & Hudson River Railroad on the "Empire State Express" trains for three years and is best illustrated and described in a book just issued by the brake company, from which the following is taken:

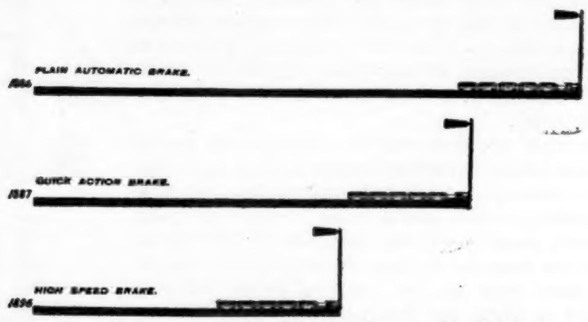
Under the conditions which have hitherto prevailed, it would seem that the quick action brake has fully met the requirements of the times. The more recent practice, however, of regularly running such trains as are now operated between New York and Buffalo, and New York and Washington, undoubtedly introduces more exacting demands for the prompt control of speed by the air-brakes, if a higher efficiency can be attained with equal reliability. So far as is now known there is but one method of increasing the efficiency of the quick action air-brake; and, realizing the importance of the new demands, advantage has been taken of this single avenue in securing the increased efficiency of the brake.

The Westinghouse-Galton experiments, carried on in England in 1878, first demonstrated that, while the adhesion between the wheel and the rail—which causes the wheels to persist in their rotation—is practically uniform at different speeds, the friction between the brakeshoe and the wheel—which resists the rotation of the wheel, and thereby stops the train—is considerably less when the wheels are revolving rapidly than when they revolve slowly. It was thereby demonstrated that a greater pressure could not only be safely applied to the wheels by the brakeshoes, at high speeds, but also that such considerably greater brakeshoe pressure must be applied in order to resist the motion of the train as effectively as with the more moderate brakeshoe pressure at low speeds. More recent investigations by the Master Car Builders' Association in this country have fully confirmed the results demonstrated in the Westinghouse-Galton experiments.

During the progress of the experiments in England, special mechanisms, of a somewhat delicate character, were employed with the old automatic brake to regulate a variable pressure of the brakeshoes upon the wheels—beginning with a considerable pressure at high speeds and reducing to a moderate pressure when the speed became much reduced—whereby much shorter train stops were secured than had ever been attained in any other way. No practical application of this apparatus was made in regular service, however, chiefly for two reasons: One was that the conditions of regular train service did not appear at that time such as to necessitate the utilization of this principle; the other was that, as already indicated, the regulating appliances there used were of a somewhat delicate and complicated nature, which appeared to be inconsistant with that exacting element of complete reliability which must characterize an air-brake apparatus.

With the invention of the quick action brake, however, the presence of the emergency brake, in addition to the ordinary automatic brake for service use, prepared the way to an entirely practical application of the principle so long ago discovered, by means of simple and reliable mechanisms. Fortunately, too, the improved brake gear, realized in the modern standards of the Master Car Builders' Association, is found to be adequate for such an increased duty as is imposed upon it in producing the increased brakeshoe pressures which are utilized at high speeds by the high-speed brake.

The apparatus of the high-speed brake is very simple. It consists of the quick action air-brake apparatus, as ordinarily applied to a passenger car, to which is added an automatic reducing valve

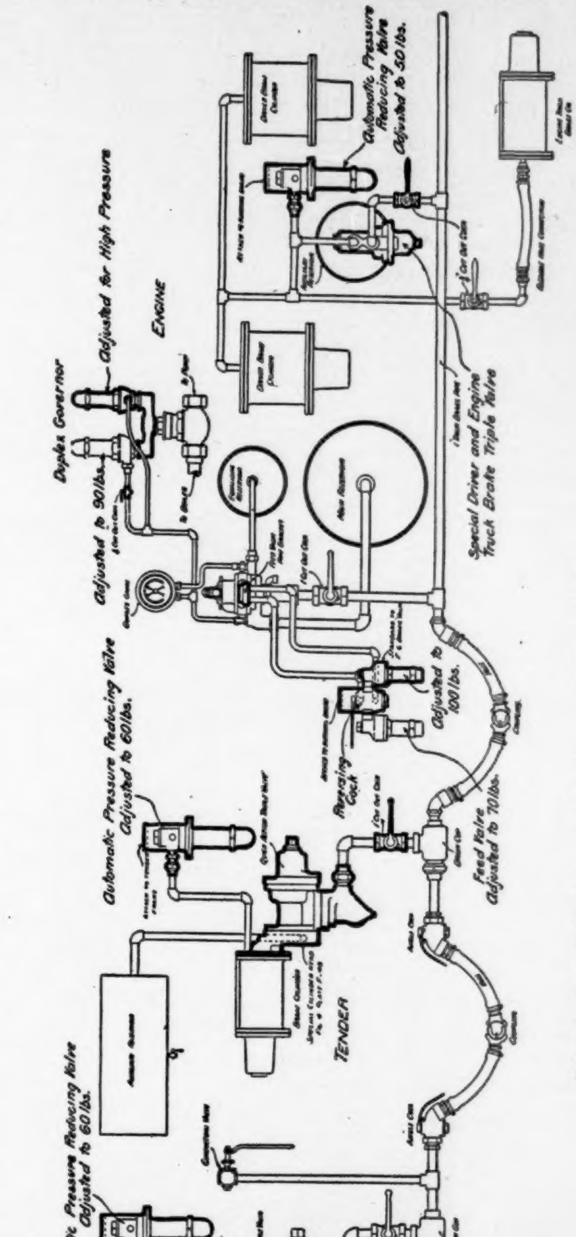


Development of the Westinghouse Air Brake.

that is adapted to be secured quite readily to the car sills or to any point in the vicinity of the brake cylinder, to which it is connected by means of suitable piping. It is, therefore, only necessary to add this pressure reducing valve to the quick action brake apparatus, already in use upon any passenger car provided with standard brake gear, to convert the apparatus into the high-speed brake. This automatic pressure reducing valve is so constructed that it remains inert in all service applications of the brake, unless, at any time, the brake cylinder pressure becomes greater than 60 pounds per square inch (for which the pressure reducing valve is ordinarily adjusted), in which case the reducing valve operates to promptly discharge from the brake cylinder as much air as is necessary to restrict the cylinder pressure to 60 pounds. It will thus at once be apparent that the maximum brake cylinder pressure, in all service applications of the brakes, is restricted to 60 pounds, regardless of the air pressure normally carried in the train pipe and auxiliary reservoirs. In an emergency application of the brakes, the violent admission of a large volume of air to the brake cylinder (only made possible by the quick action feature of locally venting the train pipe) raises the pressure more rapidly than it can be discharged through the capacious service port of the reducing valve, and the port thereby becomes partially closed, restricting the discharge of air from the brake cylinder in such a manner that the pressure in the brake cylinder does not become reduced to 60 pounds until the speed of the train has been very materially decreased.

In order to cause this apparatus to become practically effective for producing the increased stopping efficiency, the pressure of the air carried in the train pipe and auxiliary reservoirs is increased from 70 pounds (the customary standard) to about 110 pounds per square inch. With this pressure in the train pipe and auxiliary reservoirs, an emergency application of the brakes

almost instantly fills the brake cylinders with air at nearly 85 pounds pressure, thereby increasing the braking force from about 90 per cent. (the customary standard) to about 125 per cent. of the weight of the car; or, in other words, the pressure of the brakeshoes upon the wheels is about 40 per cent. greater, at this instant than is realized by the mere use of the quick action brake. The air pressure immediately begins to



Westinghouse High-Speed Brake—General Plan.

The Heavy Lines show New Parts.

escape from each brake cylinder, through the automatic reducing valve, and continues to do so until the brake cylinder pressure becomes 60 pounds, which is thereafter retained until the brakes are released by the engineer.

On account of the high pressure normally carried in the auxiliary reservoirs (110 pounds), a full service application of the brakes (charging the brake cylinders with air at 60 pounds) may be made, and still leave the pressure in the auxiliary reservoirs at nearly 100 pounds. If, after releasing the brakes, a second application of the brakes should be called for before there has been time to recharge the reservoirs, there is abundant air yet stored in the reservoirs to make a second, and even a third, full service application, and still leave sufficient air pressure to make an emergency stop equal to that of the ordinary quick action brake. These advantages, coupled with such a restricted brake cylinder pressure for all service applications of the brake, that wheel sliding is entirely avoided, require no further comment to insure recognition of their importance upon trains of unusually high speed. By simple additions to the brake apparatus on the locomotive, the train pipe pressure is easily and quickly changed to 70 pounds, when the locomotive is used in other kinds of service, and vice versa.

As a first consideration, high stopping efficiency of the brakes demands that every wheel of the entire train shall be fitted with a brakeshoe. The practice, in times past, of applying brakeshoes to only four of the wheels of six-wheel trucks has been almost universally abandoned uoon conviction of the fact that such at practice impairs the efficiency of the brakes by 33 per cent. The importance of efficient brakes upon the locomotive driving wheels is also fully recognized. In addition, however, experience with the use of brakes upon the leading locomotive truck has demonstrated the entire practicability of applying brakes to the wheels of the engine truck, and it may be unhesitatingly stated that proper security for high-speed trains requires the application of brakes to every wheel in the train. Trains scheduled to run at exceptionally high speeds are necessarily limited in respect to their weight and length, while powerful locomotives are required to haul them. It thus occurs that the weight carried to the rails by the leading truck of a locomotive is about one-twelfth that of the whole train. Neglect to provide brakes for the locomotive truck upon such trains robs the stopping efficiency of the brakes by nearly 10 per cent. It seems manifestly inconsistent to neglect such an important factor in brake efficiency, and the use of the locomotive truck brake is therefore considered an essential in every case where the superior stopping efficiency of the high-speed brake is desirable.

The high-speed brake apparatus was introduced into practical service upon the "Empire State Express" trains of the New York Central & Hudson River Railroad three years ago, and has continued in most satisfactory service since that time. During all that time, while the brake apparatus has rendered exceptionally efficient service, not a single case of slid flat wheels has been reported from the cars of those trains.

Early in October, 1894, a system of experiments with the brake, in comparison with the ordinary quick action brake, was made upon a passenger train of six cars upon the Pennsylvania Railroad. These experiments were made upon a falling grade of about 30 feet to the mile, and uniformly demonstrated that, at a speed of 60 miles per hour, the emergency stops with the high-speed brake are more than 450 feet shorter than with the ordinary quick action brake. Since that time the "Congressional Limited" trains of the Pennsylvania Railroad, running between New York and Washington, have been equipped with this apparatus, which has operated in a most efficient and highly satisfactory manner.

The record of the brake upon the fast trains of the New York Central and Pennsylvania railroads has not only demonstrated the superior efficiency of this brake apparatus, but also fully justifies confidence in the thoroughly pratical and reliable character of the apparatus.

The large diagram has been prepared to show the special high-speed brake mechanisms used in combination with the existing brake apparatus on locomotives and cars, and several illustrations are given which will make clear, with the following description, the construction and operation of the automatic reducing valve used therewith, and its adaptation to a passenger car brake.

Fig. 1 shows a vertical cross-section and Fig. 2 a horizontal cross-section through the slide valve of the reducing valve, which, in practice, is attached to some convenient point on the car or engine by its bracket X, and is connected to the brake cylinder by piping thereto from union swivel 15, Fig. 5, at Z. It will be manifest that chamber a is at all times in communication with the brake cylinder and that piston 4 will be subject to whatever pressure may be therein, while an adjusting spring, 11, on its opposite side, provides resistance to its movement downward, which is limited to chamber c, or until it strikes the upper surface of spring case 3. This assistance can be readily varied by adjusting nut 12 as may be required. Combined with piston 4 is its stem 6, fitted with two collars, between which slide valve 8 is carried and moved coincident with the movement of piston 4 when subjected to air pressure from the brake cylinder and such pressureis in excess of the resistance of spring 11. Slide valve 8 is represented by cross-hatched lines in Figs. 3, 4 and 5, and is fitted with a triangular shaped port, b, in its face, which is always in communication with chamber d, while a rectangular form of port, a, is arranged in its seat and is always in communication with the outside atmosphere at exhaust opening Y.

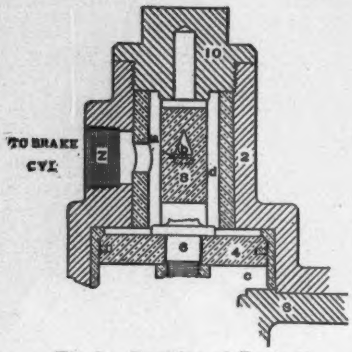


Fig. 3.—Position of Ports at Release.

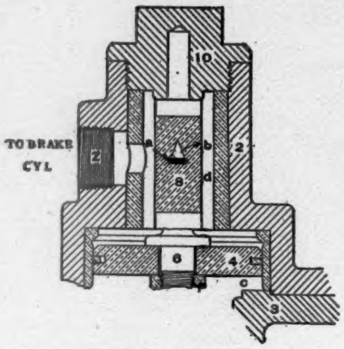


Fig. 4.—Position of Ports in Service Stop Pressure Exceeding 60 lbs. in Brake Cylinder.

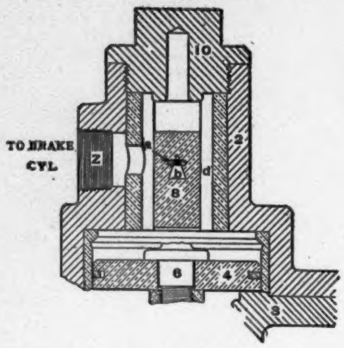
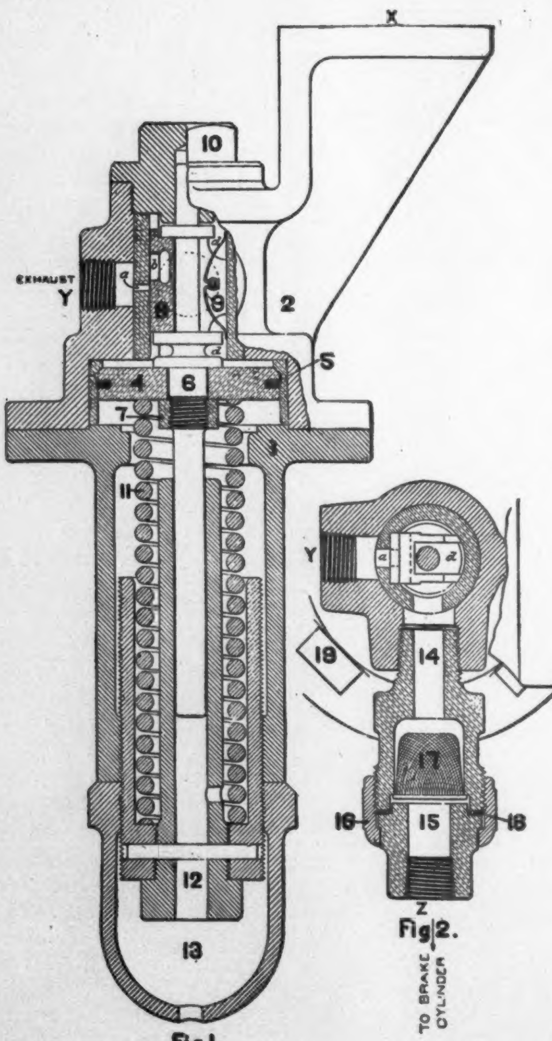


Fig. 5.—Position of Ports in Emergency Stops.

The Automatic Relief Valve of the Westinghouse High-Speed Brake.



Sections of Valve.

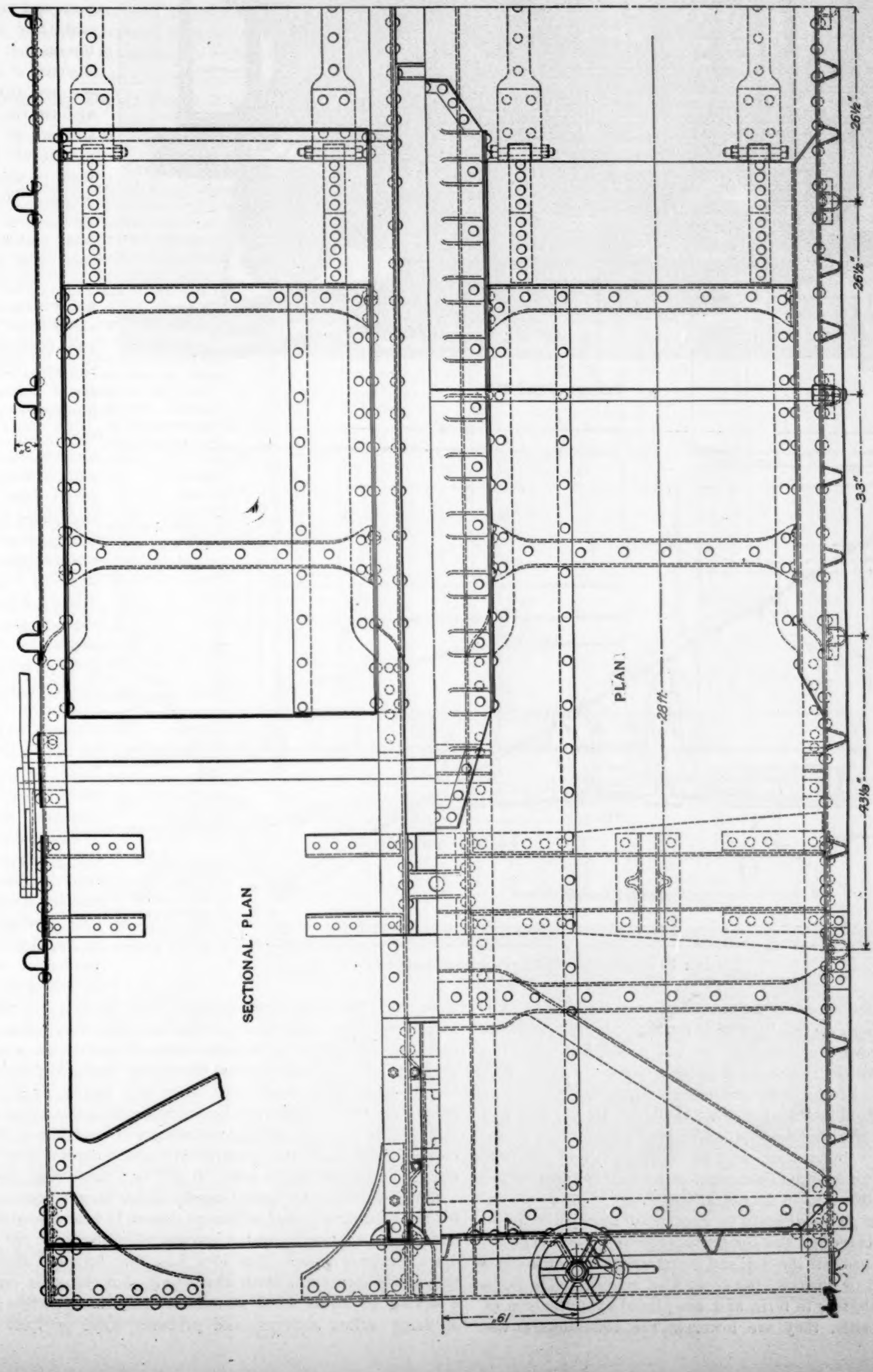
In Figs. 1 and 3 the slide valve 8 and its piston 4 are shown in the normal position occupied so long as the pressure in the brake cylinder does not exceed 60 pounds per square inch, when used with passenger car brakes, or 50 pounds when used with driver brakes, suitable adjustment for either pressure being made by compressing or releasing the tension on spring 11. It will be noted that port b in the slide valve 8 and port a in its seat in this position are not in register and the pressure is therefore retained in the cylinder until the release of the brakes is effected in the usual manner.

When the pressure in the brake cylinder exceeds 60 pounds, with an ordinary service application of the brakes the pressure acting on piston 4 moves it downward slightly until port b in the slide valve and port a in its seat are brought into register, as in Fig. 4, enabling the surplus air to be vented to the atmosphere, when spring 11 forces the piston and slide valve to their normal position, as in Figs. 1 and 3, closing the exhaust and retaining 60 pounds pressure in the cylinder. The area of ports a and b is such that in performing the function just described they are enabled to discharge the surplus air from the brake cylinder to the atmosphere quite as rapidly as it enters the brake cylinder through a port in the slide valve of the triple valve of somewhat smaller area.

The position taken by the piston 4 and slide valve 8, in an emergency application of the brakes, is shown in Fig. 5. The violent admission of air to the brake cylinder suddenly drives piston 4 throughout its entire traverse, until it rests on spring case 3, when the apex of port b in the slide valve is brought into conjunction with port a and a comparatively restricted exhaust of the brake cylinder air takes place while the train is at its highest speed, gradually increasing as the pressure on piston 4 is lessened and slowly moves the slide valve upward, in a degree proportional with the reduction of the speed of the train, until, finally closing, the desired pressure is retained in the the brake cylinder until released in the ordinary manner. In performing this function, air pressure in a large volume is discharged into the brake cylinder from both the auxiliary reservoir and train pipe through openings largely in excess of the area of ports a and b, which latter are consequently unable to discharge it to the atmosphere with equal rapidity, enabling piston 4 to be quickly driven throughout its entire possible traverse and the apex of port b is presented to port a, giving an area through which the excess air is slowly discharged to the atmosphere, but gradually increasing in a required degree as the piston and slide valve ascend to their normally closed position.

The Schoen Steel Cars.

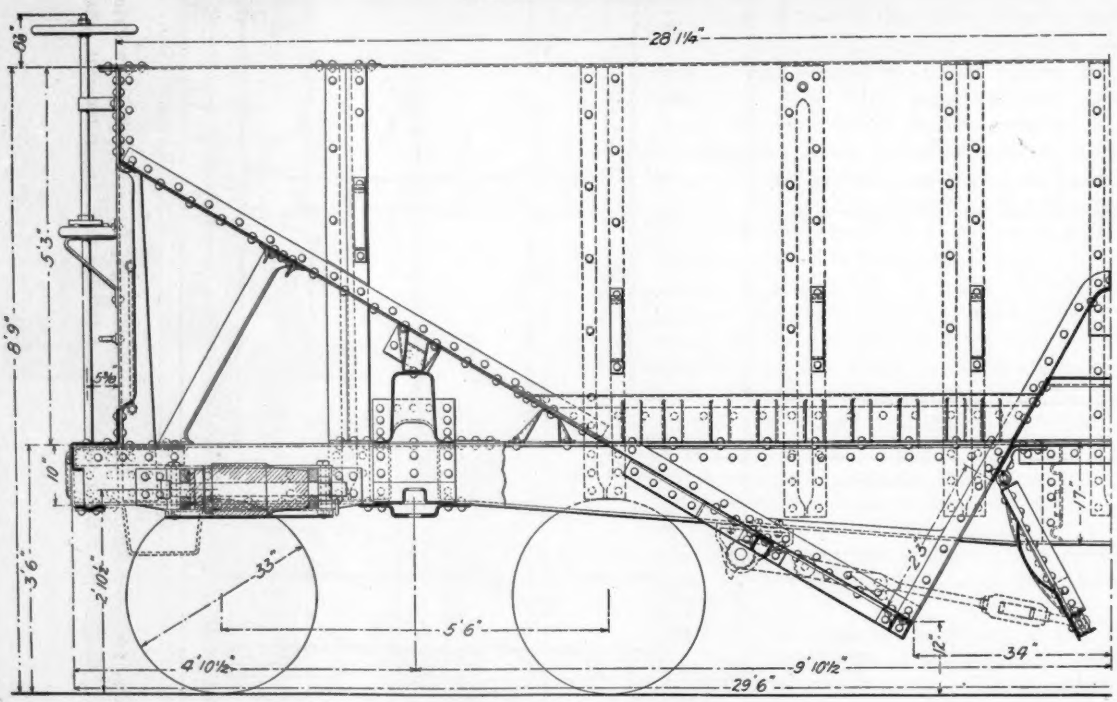
In our accounts of the recent conventions at Old Point Comfort the pressed steel cars recently built by the Schoen Pressed Steel Company, of Pittsburgh, Pa., were mentioned as a feature which marked progress in the construction of metallic cars. These cars, two of which were exhibited at the conventions, were built as a part of the order of 600 for the Pittsburgh, Bessemer & Lake Erie Railroad, the designs, including the trucks, being by Mr. Charles T. Schoen. The cars have a capacity of 100,000 pounds and are of the double-hopper gondola type. Through the courtesy of the builders we are enabled to illustrate and describe their construction, which is of peculiar interest at this time because of newness of the art of building heavy steel cars and because of the engineering work which is embodied in the arrangement of the parts for the purpose of securing lightness·



Steel Cars, 100,000 Pounds Capacity—Pittsburgh, Bessemer & Lake Erie Railroad.

Designed and Built by the Schoen Pressed Steel Co., Pittsburgh, Pa.

Schoen Steel Car.



Schoen Steel Car—Half Longitudinal Section.

center, as shown in the drawings and this feature permits of using the surplus material from the ends as gusset bracing to strengthen the car against twisting stresses. The half sectional and half end view illustrates the manner in which the ends of the bolsters are turned up against the sides of the car in order to permit of a secure form of attachment without interfering with the riveted joint between the sides and the side sills. The longitudinal section and plan views show the form and attachment of the end sills, which are of a single plate gusseted to all of the sills. The hoppers provide ample transverse stiffening and longitudinal pressed and ribbed roofs over the center sills brace the hoppers lengthwise of the car. There is a transverse roof between the hoppers, which, together with the transverse supporting channels for the floors of the hoppers, furnish the lateral tying of the car body. The cars are equipped with the Westinghouse friction draft and buffing appliance and nickel steel axles. The journals are 5 by 9 inches, and the proportion of nickel in the axles is about 3 per cent. The symmetry and simplicity of construction were commented upon by many who saw the cars at the conventions. These points were effected by the innovation of the designer upon the old practice of designing metal structures. Instead of using rolled sections, such as channels, eye-beams and angles, as is common among structural engineers, he has resorted to the use of pressed-steel shapes entirely, taking steel plate and pressing it into the correct shape to get the greatest strength with the least weight. For example, look at the sills. It will be noticed that they are of channel section. A channel made in this way is just as strong for the strains to be met as though it were 17 inches deep throughout its entire length, and a saving of probably 30 per cent. in dead weight is made. This idea has been followed throughout the entire structure, with the result that, as it is estimated, a saving of about 4,000 pounds is gained over the practice of using rolled sections, and probably 6,000 or 7,000 pounds

together with the necessary strength. These cars weigh only 34,100 pounds each as against 39,950 pounds for a somewhat similar design brought out by the Carnegie people last year, the difference between the two weights being due chiefly to the substitution of pressed steel for rolled shapes.

The trucks were illustrated in our issue of August 1896 and readers are referred to that description for details concerning them. The new cars are built upon an underframe consisting of four longitudinal sills of channel form which are 17 inches deep at the center, tapering down to 10 inches at the ends. The sides consist of continuous plates stiffened by verticals of steel pressed into a form giving a U section and for futher stiffening the side plates are flanged inward at the top and bottom edges. The bottom flange is riveted to the top flange of the side sill. The body bolsters are rectangular in form and are placed upon the tops of the longitudinal sills; they are lower at the ends than at the

is gained over the use of a wooden structure of equal capacity.

A great reduction in the number of parts is effected. For example, the side sheeting is all one piece and flanged at top and bottom, thus avoiding the necessity of riveting angles around these points. The floor sheeting is flanged on the edges, making only one row of rivets necessary instead of two rows, as would be the case were the floor attached with angles to the sides. Throughout the entire structure this idea has been carried out, and the riveting required is only about two-thirds of what would be required for a structure of rolled sections. This reduction of parts is an important feature, because, aside from the other advantages, it is one of the sources of economy in maintenance.

Electricity Under Steam Railway Conditions.

BY GEORGE S. STRONG.

(*Second Paper.*)

One of the arguments of the advocates of electricity for steam railway conditions is, that on stationary plants a lower grade of coal can be used to advantage than can be used on ordinary locomotives, and one company experimenting with electricity on one or two of its branch lines makes a great point of its ability to burn sparks taken from the front ends of its ordinary locomotives, and states that from 700 to 800 carloads of such sparks are produced per month on its lines and that one ton of these sparks is equal to a half ton of coal.

With properly designed locomotives, this condition of things would not obtain, as it has been thorouhgly and abundantly demonstrated that, with a properly designed locomotive firebox, these same sparks can be burned on a locomotive, and that such an engine will take the finest slack of bituminous coal and burn it without throwing any sparks, without taking them out of the firebox and without making any smoke. This is only a question of sufficient grate area to burn enough coal to do the work without lifting the coal off the grates.

This can be accomplished by two methods—by employing large grates and large boiler capacity, or by what is better, a combination of large grates and boiler capacity with compounding, which reduces the demands on the boiler, and also reduces the fierce blast to a gentle fanning action of the fire, greatly increasing the evaporation per pound of coal, as well as reducing the quantity of water to be evaporated.

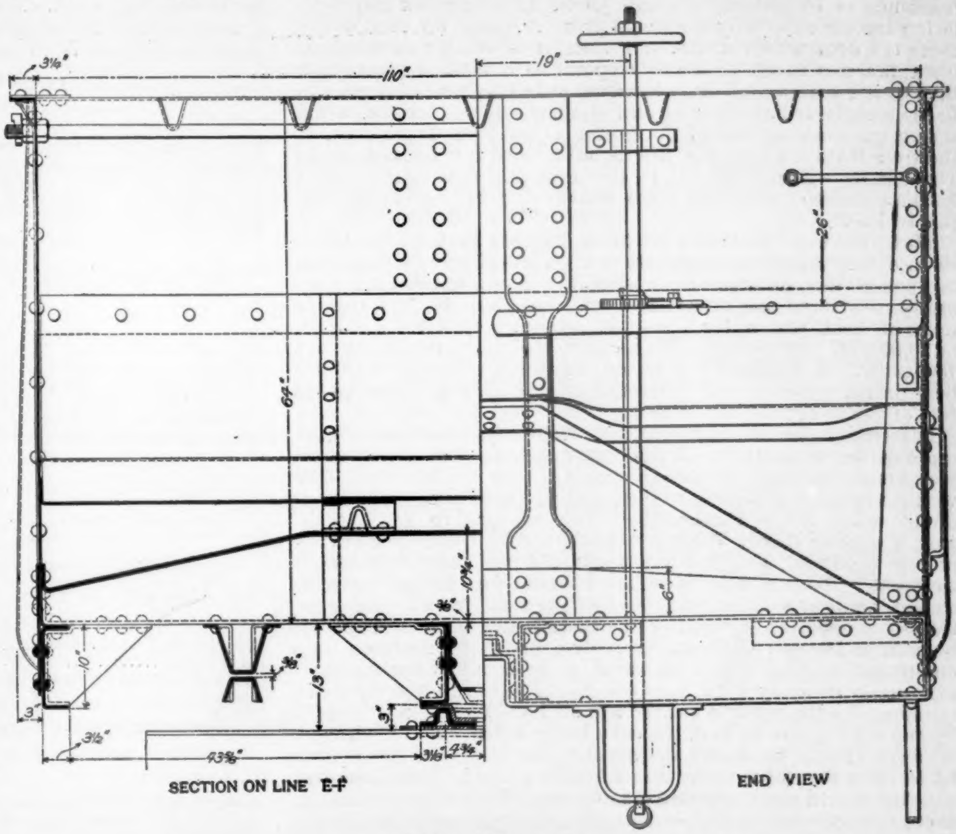
If the railroad that is displaying so much energy in its electrical experiments had displayed the same kind of zeal in locomotive improvements, it would not to-day have from 700 to 800 carloads of sparks to pay for each month.

This spark question, and also the smoke question, for all roads having a large suburban business, are giving much trouble, and must be met in some way. As soft coal seems to be the fuel from which our power for all purposes must come, because anthracite is becoming too expensive for power purposes especially in locomotive work, there are two reasons why railroads having a large suburban population to deal with should overcome the smoke and spark nuisances. The first one is, that it would save them a large amount of money in not having the ballast and roadbed filled with black carbon, which is picked up by every passing train and creates a nuisance, soiling the cars inside and out, and adding greatly to the cost of painting as well as to the uphosterers' bills. This also constitutes a nuisance for all the residences situated near the tracks.

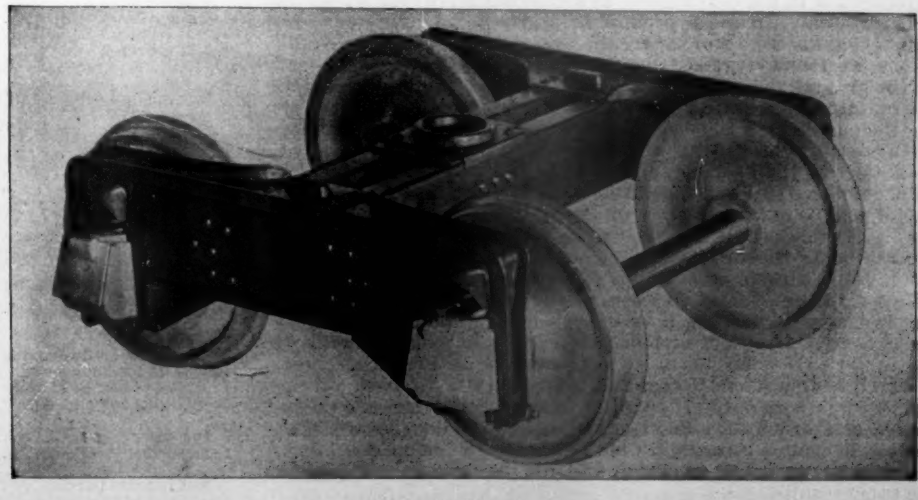
The most promising remedy seems to be in the coking of the coal at the point where it is to be used, in modern by-product ovens, and using the gas from these ovens for fuel for the suburban work, as compressed gas, either on steam motor cars for main line work where high speeds have to be made between stations, or on gas motor cars for street-car work, and for feeders—the latter class of cars doing all work where it is not desired to run faster than 30 miles per hour, and the steam motor cars doing work that required speeds up to 60 or 70 miles between stations.

Recent tests of a gas-motor car in Germany demonstrated its ability to move a ton one mile for from three quarters to one cubic foot of gas. According to Mr. Davis' figures for electric traction one pound of coal moved 2,500 pounds one mile. One pound of coal has 10,000 available heat units, while one cubic foot of coal gas has 750, or one pound of coal has $13\frac{1}{3}$ times the number of heat units that one cubic foot of coal gas has. If the electric motor has been equally efficient with the gas motor, in proportion to the available heat units used, it would have moved $13\frac{1}{3}$ tons one mile, instead of $1\frac{1}{4}$ tons, so that we must conclude that the gas motor will do its work on one-tenth of the heat units required for electrical equipment.

From this and the foregoing figures we must also arrive at the



Schoen Steel Car.



Schoen Steel Truck.

conclusion that the steam motor car with gas as fuel, and allowing $33\frac{1}{3}$ cubic feet per horse-power per hour will use about one-fifth of the heat units that would be required to do the same work by electricity, as proposed by Mr. Davis and other electrical engineers. This is largely accounted for by the great losses outlined in the first paper, and by the fact that with the gas motor car, either using steam or by the direct use of the gas engine, the power is also generated as used, and if there be not a demand for power, no heat is being produced, and the gas reservoir is a reservoir of power to be drawn on at will and is always ready to respond instantly, without waiting to distill gas and then burn it to make heat, as in a stationary plant. The value of this feature is well illustrated by the use of gas stoves for cooking, where gas costing $1.25 per thousand is burned in competition with anthracite coal costing $5.75 per ton, and it is found that the same work can be done for about one-half of the cost by the use of gas, as it is only burned while actually required, while the coal fire has to be kindled and allowed to burn out, producing much more heat than is wanted, and producing it at a time when it cannot be utilized.

As to the economy of the use of gas as fuel for a steam motor, it has certain very great advantages. It can be burned so as to produce perfect combustion at all times, and need only be burned when there is work to be done. In this respect, it is somewhat like electricity as applied to stationary motors or machine tools, inasmuch as by keeping a small jet lit in the firebox and regulating the gas supply by the steam pressure, gas is not used unless there is a demand for steam, and then it is ready and is almost instantaneous in its action to respond to a demand for a quick fire; while, with an ordinary locomotive in this kind of service, a fire is maintained at all times and of about equal intensity, while the actual working time of the engine is but 25 to 30 per cent. of the time from the time the fire is built, until it is banked again. This loss as was pointed out in the first paper is equally great with a stationary electrical plant that is subject to great fluctuation of load.

While the heat units in a pound of burning carbon are 14,000, the ordinary American coals are not pure and have a large percentage of ash, moisture and other impurities, so that it is generally considered that an average coal has about 10,000 available units of heat, which, for a net ton, would give $2,000 \times 10,000$, or 20,000,000 heat units; while a cubic foot of good coal gas has 750 units. A thousand feet would have $750 \times 1,000$, or 750,000 heat units, which would theoretically call for the use of 26,660 feet of gas to equal a ton of coal.

Practically, for the reasons stated above and by reason of the more perfect combustion of the gas, not more than 13,333 cubic feet would be required to do the work of one ton of coal. This would be allowing $33\frac{1}{3}$ feet to the horse-power developed, or about double what is found necessary in the best modern gas engines. But, it may be asked, What is to be done with the large quantity of coke produced, and how much will the gas cost per thousand to make? To the first question I would reply that the coke should be used as the regular fuel of the road for all passenger trains not operated by gas, and if there is any surplus it should be used on freight, and with properly constructed fireboxes and compound engines it will be found to be excellent fuel and will eventually do away with both the smoke nuisance and the spark question, for the volatile matter will all have been taken out of it by the coking process and, the coke being solidified into chunks, it offers greater resistance against the blast and is not so readily lifted from the fire as is the fine air-slacked coal. But one may say that it will not make steam as freely. With a proper firebox there is no trouble on that score. It has been used successfully for years on many roads, simply to get rid of the smoke, and because it is cheaper than anthracite; but these roads have purchased it in the coal regions and it costs more purchased in that way than if made as proposed. I give below five tables on cost of making coke and saving the by-products, one being at the mines in Pennsylvania, one contemplating burning the gas on the ground, one piping it to a near-by town and selling it, and one on taking the coal to where the coke was to be used and selling the gas there at 30 cents per thousand cubic feet. The fourth table is assumed for a city where good soft coal is delivered on the tender at $1.25 per ton, and where the coke is of equal value for locomotive fuel and the amount of coke from the given quantity of coal is to be delivered to the locomotive department at the same price as coal would cost. Allowing 10 cents per thousand as being the value of the gas for street-car and suburban work, for gas motor cars, $58\frac{14}{17}$ horse-power hours would be obtained for 10 cents, and on steam motor cars, allowing $33\frac{1}{3}$ cubic feet per horse-power, $30\frac{1}{4}$ horse-power hours would be obtained for 10 cents. If we allow 13,333 feet of gas to do the work of one ton of coal on an ordinary locomotive or an electrical plant, it would be equivalent to coal at $$1.33\frac{1}{3}$ a ton; or, if used on the gas motor, where only 17 feet of gas are required for one horse-power, and only 6,800 cubic feet are required to do the work of one ton of coal on an ordinary locomotive or an electrical plant, it would be equivalent to coal at 68 cents per ton to accomplish the same results.

The above figures and facts in regard to the possibilities of coking and gas production for this kind of work are taken from actual practice and can be substantiated, and it would seem as if they were worthy of careful consideration by railroad men who are contemplating some change to meet electrical competition.

If it be not desired to use coke as fuel on locomotives, then a ready sale for it can be found in any city in the country for domestic, foundry and furnace purposes. The price to-day of crushed coke in the city that I have mentioned as being able to supply coal at $1.25 on the locomotive tenders is $4.30, and anthracite coal for domestic purposes costs from $6.50 to $7; and as this city is the largest market in the United States for pig iron, it is naturally supposed to be a good distributing point for coke for furnace and foundry purposes; again, as the smoke question is one that has given great annoyance, the introduction of large quantities of coke for domestic purposes at a reasonable price would go a long way toward the solution and problem. For this reason the writer gives a table of the cost and profits of the operation of a coking plant at this point, the gas being used and the coke being sold at present market prices. The writer is informed by a dealer in coke and coal in another Western city that he supplies the gas company with its coal and takes all the coke and pays the gas company a large amount of money each year for the difference in value of the gas-house coke and the market value of the coal from which it was manufactured.

Now, we all know that there is no comparison between gas-house coke and good, clean, crushed coke, made in a coke oven. Crushed coke is about equal to the average anthracite, and is generally much freer from sulphur and ash, which make clinkers.

STATEMENTS OF OPERATIONS.

120 OVENS AT MINES.

EXPENSES.

840 gross tons coal for for oven coking in 30 hours.	
672 gross tons per day, at 55 cents	$369.60
Labor per ton coking, at 25 cents (541 tons)	135.25
Incidentals and repairs, at 20 cents	108.20
72 tons producer coal, at 55 cents	39.60
Producer's labor	24 00
	$676.65
General expenses, 25 per cent	169.16
	$845.81

RECEIPTS.

5,000,000 cubic feet gas, at 20 cents per 1,000	$1,000,000
161,000 liquor ounces ammonia, at 10 cents per 100	161.00
20 tons tar, at $7 per ton	140.00
541 net tons coke, at $4.20, less freight to Lehigh Valley, equal say ¾ cents per ton per mile, equal $1.40, equal $4.20, equal $2 at Connellsville, present price $4.50	1,514.80
Income per day	$2,815.80
Expenses per day	845.81
Net income per day	$1,969.99
	300
Net income per year of 300 days	$590,997.00

120 OVENS AT MINES, SURPLUS GAS USED ON THE GROUNDS.

EXPENSES.

672 tons coal, at 55 cents	$369.60
Labor	135.25
Incidentals and repairs	108.20
	$613.05
General expenses, 25 per cent	153 26
	$766.31

RECEIPTS.

2,000,000 feet surplus gas, at 2 cents per 1,000	$40.00
161,000 liquor ounces ammonia, at 10 cents per 100	161.00
20 tons tar, at $7	140.00
541 tons coke, at $2.80	1,514.80
Income per day	$1,855.80
Expenses per day	766.31
Net income per day	$1,089.49
	300
Net income per year of 300 days	$326,847.00

120 OVENS IN LEHIGH VALLEY.

EXPENSES.

672 tons coal, at $2	$1,344.00
Labor	135.25
Incidentals and repairs	108.20
72 tons producer coal, at $2	144.00
Producer labor	24.00
	$1,755.45
General expenses, same as at mines	169.16
	$1,924.36

RECEIPTS.

5,000,000 cubic feet gas, at 30 cents per 1,000	$1,500.00
161,000 liquor ounces ammonia	161.00
20 tons tar, at $7 per ton	140.00
541 tons coke, at $4.20	2,272.20
Income per day	$4,073.20
Expenses per day	1,924.36
Net income per day	$2,148.84
	300
Net income per year of 300 days	$644,652.00

PRODUCT OF 120 OVENS AT A POINT WHERE COAL IS WORTH $.25, THE COKE IS TO BE BURNED ON LOCOMOTIVES.

EXPENSES.

672 tons coal, at $1.25	$840.00
Labor	135.00
Incidentals and repairs	168.00
72 tons producer coal, at $1.25	90.00
Producer labor	24 00
General expenses, including interest	155.00
	$1,352.(0

RECEIPTS.

5,000,000 cubic fe t gas, at 10c. per 1,000	$500.00
161,0'0 liquor ounces ammonia, at 10 cents per 100	161.00
20 tons tar, at $7 per ton	140.00
541 tons coke, at $1.25	676.25
	$1,577.25
Net income per day	$225.25
Net income per year of 300 days	67,575.00

PRODUCT OF 120 OVENS AT A POINT WHERE COKE IS WORTH $4.30 PER TON AND COAL IS WORTH $1.25.

EXPENSES.

672 tons coal, at $1.25	$840.00
Labor, 25c. per ton of coke	135.00
Incidentals and repairs	108.00
72 tons producer coal at $1.25	90.00
Producer labor	24.00
General expenses, including interest	155.00
	$1,352.00

RECEIPTS.

5,000,000 cubic feet gas at 10 cents per 1,000	$500.00
Ammonia, 161,000	161.00
Tar, 20 tons at $7	140.00
541 tons coke, at $4.30	2,326.30
	$3,127.30
Income per day	$1,775.30
Income per year of 300 days	$532,590.00

Thermal Tests for Wheels.

Attention was called in our issue of June, 1896, to the fact that the Pennsylvania Railroad from investigations of the subject of failures of cast-iron wheels had instituted a thermal test, and the correctness of the idea is demonstrated by further pursuit of the subject. It might have been expected that such a radical departure in specifications for wheels as the requirement of thermal tests would cause considerable discussion before the Master Car Builders' Association, but the plan seems to be a needed improvement and was accepted as such. Mr. G. L. Potter stated the value of thermal tests in one of the noon-hour discussions as follows:

"During recent years the competition in railroad business has resulted in a marked increase in the speed and size of trains and in the size and carrying capacity of the cars. These new conditions developed weaknesses in some parts of the equipment and made it necessary to devise means that would reduce the failures of the important parts to the minimum.

"One more or less serious cause of wrecks is due to the breakage of wheels. In some cases the failures are due to want of proper inspection, whereby wheels which are worn through the chill, or have seams in the tread or other defects, are allowed to remain in service longer than they should. There is, however, one cause of breakage of wheels that the most careful inspection cannot prevent, namely, that due to the expansion of the tread caused by long and severe application of the brakes, frequently necessary on long, steep grades or in controlling heavy fast trains with a few air-brake cars, resulting in the tread becoming very hot, causing it to expand, thereby introducing strains in the wheel which it cannot resist.

"In considering the subject with a view to overcoming failures from this cause it was thought that the introduction of specifications requiring representative wheels to stand a test which would bring upon them the same strains that are produced by severe brake application, would result in producing wheels that would be safe to use under the most trying conditions. Such specifications, which are similar to those recommended by the committee appointed to report to this convention on 'Specifications and Guarantees for Cast-iron Wheels,' have been in use for a year or more, with very satifactory results. The manufacturers experienced some difficulty at first in meeting the requirements of the specifications, but soon found that by the use of the proper metals and care in annealing, the difficulties could be readily overcome.

"The carrying capacity of freight cars having increased in a much greater ratio than the weight, and as the braking power that can be used on such cars is limited by the light weight of same, and with the greater speeds of to-day, the wheels receive much more severe punishment from the brakes than formerly, and as the amount of double tracks is constantly being extended, making it still more necessary to take additional precautions to prevent wrecks on account of the possibility of trains on the other track being wrecked also, wheels furnished under specifications requiring such thermal test as is now in use and as proposed by the committee to report on wheel specification will surely be safer to use than those furnished under no specifications or specifications requiring only a drop test, which subjects the wheel to shocks that it seldom, if ever, receives in service. It has been advanced that it is possible to make wheels that would meet the termal test, but that owing to the nature of the metal used (it being too soft or having other properties that would prevent it chilling properly) would not necessarily give good service in so far as wear is concerned, but this can be provided against by requiring the maker to guarantee the wheels to give a proper time or mileage service."

Henry B. Stone.

The death of Henry B. Stone, formerly Vice-President of the Chicago, Burlington & Quincy Railroad, which resulted from an accident at Nonquitt, Mass., July 5, removed one of the men of whom any country might be justly proud. He was but 45 years old, and his life was so full of promise that had he lived a few years longer, he would, without doubt, have made his name still more favorably and widely known. A friend who was close to him for 19 years says that he had come to regard him more and more as a man of exceptional ability. He was energetic, courageous, ambitious and industrious, and, withal, his was an uncommon integrity; in short, he was a type of the very highest standard of American citizenship. His railroad work, wherein his ability as an organizer and executive were brought out, was, perhaps, his greatest success, although he showed the same keenness and command of difficult situations in his later undertakings. His remarkable ability as an executive was seen in the conduct of the great C., B. & Q. strikes of 1888 when he was General Manager of that road. There are differences of opinion as to the wisdom of the policy which was then followed by him, but there can be no doubt of the fact that he put the wishes of his superiors into effect and in so doing he made use in a masterly way of every factor which could be employed to carry out the purpose in hand. It must be conceded that there are few positions as trying as was his at that time, and the fact that in the past nine years railroad strikes have been so few in number must in a large part be credited to him. It is significant that one of the men who stood under him at that time now says: "We always felt very sure that what Mr. Stone said and did would be right." He was conscientious and had the respect and confidence of his staff in all that trouble. His death cast a gloom over the employees of that road, though he had not been connected with it for seven years. The American Railway Association owes much of its present successful standing to Mr. Stone and his assistance in carrying through the project of the World's Fair in Chicago contributed materially to the ultimate success of that undertaking. He was highly honored by the Commercial Club of Chicago, in being sought among many broad-minded, progressive, successful men as its President, but declined.

Mr. Stone was educated for the bar at Harvard University, but owing to a tendency toward deafness, which was afterward over come, he gave up that profession and took a course in mechanical engineering at the Massachusetts Institute of Technology. After graduation he became connected with an ordnance concern in Boston, and, while successful in that line, he found that the field was not in every way suited to his ambition, and in 1878 he resigned a position which was lucrative in order to take a position as journeyman machinist in the mechanical department of the C., B. & Q. Railroad, at Aurora. He was soon promoted to the position of gang foreman and always took great interest in an engine that was built under his supervision. After that he was employed by Mr. Challender, then Superintendent of Motive Power, on the special duty of investigating devices and methods that were being looked into and tested on the engines. His next promotion was to the position of Division Master Mechanic at Aurora. When Mr. Challender resigned Mr. Stone succeeded him as Superintendent of Motive Power Jan. 1, 1880, and was made General Superintendent in the fall of 1881. Subsequently he was made Assistant General Manager, and May 1, 1885, General Manager. Nov. 1, 1888, Mr. Stone was appointed Vice-President, and in 1890 he resigned to take the Presidency of the Chicago and United Telephone companies. Mr. Stone was a rare man, and of his life the chief lesson for young men appears to be the value of preparation by education and continuous study, coupled with indomitable perseverance and energy in fulfilling the trusts which were reposed in him. His selection of subordinates was wise, and his treatment of them was such as to bring out all their best capabilities, and these are now among his greatest admirers and sincerest mourners.

(Established 1832.)

AMERICAN ENGINEER CAR BUILDER AND RAILROAD JOURNAL.

28TH YEAR. 66TH YEAR.

PUBLISHED MONTHLY

BY

R. M. VAN ARSDALE,

MORSE BUILDING..NEW YORK

G. M. BASFORD, Editor.

AUGUST, 1897.

Subscription.—*$2.00 a year for the United States and Canada; $2.50 a year to Foreign Countries embraced in the Universal Postal Union.*
Subscriptions for this paper will be received and copies kept for sale by the Post Office News Co., 217 Dearborn Street, Chicago, Ill.

EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Special Notice.—*As the* AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL *is printed and ready for mailing on the last day of the month, correspondence, advertisements, etc., intended for insertion must be received not later than the 25th day of each month.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

To Subscribers.—*The* AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.* **When a subscriber changes his address** *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

The paper may be obtained and subscriptions for it sent to the following agencies: **Chicago,** *Post Office News Co., 217 Dearborn Street.* **London, Eng.,** *Sampson Low, Marston & Co., Limited St. Dunstan's House, Fetter Lane, E. C.*

The suggestions with regard to the use of gas made by Mr. Strong in this issue in discussing the subject of "Electricity Under Steam Railway Conditions" are interesting, and in this connection attention is also called to the paragraph under the caption "The Future of Fuel Gas," which we reprint from a recent issue of the *Engineering and Mining Journal.* The utilization of the great wastes from coke ovens is a most praiseworthy field for the exercise of engineering thought and talent. Not the least important of the effects of the introduction of electricity into engineering operations is that other methods of producing power are likely to reach a higher degree of development on account of what is practically a rivalry between the different methods.

In view of the great advantages offered by uniformity or standardizing in the construction of machinery, it is unfortunate that so little attention has been paid to this matter in the designs of the machinery for the ships of the United States Navy. If too much stress were laid upon standards, progress and improvement might be sacrificed; but there is no reason why uniformity cannot be carried out on a number of ships or torpodo boats which are built at about the same time. The new navy is to a great extent experimental, and this appears to offer an additional reason why new designs should be tried in such a way as to bring out the results of several applications of the same thing. Evidently an attempt was made to carry out this idea in ships Nos. 5 and 6, and also in Nos. 7, 8 and 9, but it was done only partially, and all five of these ships might as well have been from the same designs.

It would be expensive to go deeply into interchangeability, yet the convenience of being able to carry extra parts of machinery is so great, and the saving of delay in making repairs might under certain circumstances be so important that the plan is worthy of careful consideration. The interchangeable feature of the three-throw crank shafts of the battleship *Iowa* is a valuable one. The cranked portion of the shaft is made in three sections, which are so nearly duplicates of each other as to permit of carrying a spare section on the ship, that will fit in place of any section in case of accident. There appears to be no reason why this idea cannot be developed so that a spare shaft would fit in any of a half-dozen or more ships or torpedo vessels. The latter vessels, by the way, are specially liable to suffer breakdowns on account of the high speed of their machinery.

English travelers pay a good price for their privacy in railroad trains and the increasing frequency of outrages in compartment cars has at last brought the matter to the point of investigation by a "Department Committee." Proper means for communication between compartments and between cars are needed and the easiest way out of the difficulty would appear to be the provision of the equivalent of the methods which have found such favor in this country. If privacy must be had why not build compartment cars with corridors and vestibules? From an American standpoint the English roads can hardly introduce a greater improvement than this in their methods of car construction. The wonder is that it was not generally adopted long ago.

The list of horrible accidents which have occurred through the lack of protection of drawbridges over which electric street cars are operated has been lengthened by the running of a car off a bridge abutment at Bay City, Mich., July 7. The dead number eight, and the accident was apparently due to the total lack of signal protection to the bridge. It is stated that the car was racing with a steam train, which makes the case so much the worse, justifying the suggestion that that the first principles of railroading should be applied to street car operation. The public knows all about these disasters and that no action compelling railways in the streets to provide proper protection to such points is most unaccountable. Drawbridges constitute the most dangerous element in railroading, and even when properly signaled are bad enough, but to leave them absolutely without safeguards must be characterized as criminal before the moral law. The steam railroads are not wholly out of reach of a corresponding charge. Only a few weeks ago a part of a suburban train on one of the leading Western roads ran into a river through an open draw—the only protection provided being an antiquated signboard with the outline of a fish, the position of which is intended to indicate whether or not a passing train will take a dive into the river. This bridge happens to be a difficult one to provide with signals, but the celerity with which the work will be accomplished after a serious accident occurs there will doubtless prove that it can be signaled. It is to be hoped that such a case will not arise, and that precautions will be taken to prevent it. This road has given a great deal of attention to its signaling, but the one place left out may be chosen as the scene of disaster.

Economical use of lubricating oil on locomotives is important to railroads, justifying the attention given to the subject, and one of the railroad clubs has just discussed it in the hope of ascertaining a proper mileage to allow per pint of oil. Any means by which the cost of operation may be reduced is of course important, but this seems to be an item, like the prices paid for piecework, which should not be subject to comparisons among different roads unless they are all working under the same conditions. Nowadays little weight is placed upon comparative records of repairs or fuel when based upon the locomotive mile,

because the work done is not given consideration, and the same should hold true of other factors of expense which are affected by the amount of work done. Comparisons of oil consumption made upon the same road year by year, and based upon tonnage and distance, would appear to be of real value, and such figures might be advantageously compared in a general way with those from other neighboring roads. It does not, however, seem at all necessary that the results obtained by men on road A should be compared with those on road B in order to enlist interest in the subject of economy in the use of oil, and it is probable that the men themselves would place more confidence in comparisons which they could see and understand to be correct and fair. It would, perhaps, be a good plan to enlist the interest of locomotive men in the economy of repairs based upon the ton-mileage made by their engines, and to let the oil records come into the rating of the men in regard to the cost of keeping up the equipment. If this is not done in some way a danger exists in the tendency to save oil without due regard to imperfect lubrication. A cut cylinder would cost more for repairs and loss of time of the engine than would be balanced by the saving of a great deal of oil. The cost of repairs will receive increasing attention during the next few years, and it seems logical to suggest the relation between wear and lubrication as having an important bearing upon the cost of maintenance based on ton mileage.

The use of higher pressure in marine practice is attracting greater attention to nickel steel as a material for boiler construction and the United States Navy experiments are not the only ones devoted to the investigation of the merits of this alloy for boiler work. English engineers have taken the subject up with vigor and with promising results. The water tube boiler has not yet made much progress in marine work outside of naval vessels and there are good reasons for believing that the cylindrical type will continue in favor in merchant ships and in stationary practice. The limit of pressure in cylindrical boilers is fixed by the thickness of the shells of the boilers and with the superior strength of nickel steel the plates can without doubt be made much thinner than the use of ordinary steel would require. The boilers for the United States battleships Nos. 7, 8 and 9 will carry 180 pounds pressure per square inch and the shell plates are nearly one and one half inches thick. It is obvious that large boilers for pressures higher than this must be so heavy as to render these and higher pressures undesirable and nickel steel will be welcomed by designers who have these problems to work out. Mr. Beardmore who recently read a paper upon the subject of this alloy before the Institution of Naval Architects, points out an important property which it poseesses, in that it does not develop cracks as does ordinary steel. The progressive breaking of axles, for instance, so often found in those of ordinary steel, does not seem to occur in nickel steel, and this constitutes an advantage which would appear to render the material specially well adapted to railroad work for tires, axles, piston rods and crank pins. With increased strength, high elastic limit and no sacrifice of ductility a wide field of usefulness seems to open before nickel steel and an extended use of it is expected.

Education is a preparation for the work of life and that education is best which best fits the dupil for meeting the problems which are to confront him when he has no professor at hand to advise and show him how to meet difficulties. Much could be said about best methods of acquiring the ideal education, and there are as many ideals as there are friends of education. The knowledge acquired from books, that absorbed from personal acquaintance with instructors and that obtained inductively from investigation are all important, but there is another factor in education which must not be ignored, that is, the ability to conduct enterprises. There is much to be had from a school course aside from the academic advantages, and as Mr. Wm. S. Aldrich puts it, the highest honor man at college is frequently, in fact, usually, distanced in after life by the all-round man who studies fairly well, and who, at the same time, knows how to dance, to skate, to play football and to make himself agreeable to the young ladies as well as to his fellow-students. Both these men are sometimes surpassed by the man who has never had a college education, for the latter, in his efforts at self-education, never finds a stopping place, while the college man is apt to think himself educated when he receives his diploma. The advantage is with the college man, however, for he is like the man who has taken time to grind his axe before going to the woods, while the other is like the man who starts with a dull axe, and who is lucky, indeed, if he finds time to sharpen it, though he may have cut many trees before the other gets started.

LONG LOCOMOTIVE RUNS.

There is a marked contrast between English and American methods of operating heavy express passenger service in the length of the continuous runs, those of England often reaching 150 miles, whereas in this country there are comparatively few continuous runs of over 60 miles. There were in England last year 55 regular continuous runs of 100 miles or over. The long runs are desirable in many respects, and yet for good reasons we shall probably be obliged to be contented with shorter ones in this country for many years. The lengthening of locomotive runs regardless of the number of stops is, however, a very different matter, and it is possible to extend them to limits which are set by the shortcomings of the fuel used. More attention is now given to this subject than ever before, and as a result we have one locomotive run of 495 miles per day on the Chicago, Burlington & Quincy which consists of doubling a distance of 242.5, and is doubtless in excess of any daily mileage elsewhere.

The reasons for seeking to increase the length of runs are simple. It is advisable for mechanical reasons to keep the boilers in service as constantly as possible, and it is important from a commercial standpoint to get the mileage service from locomotives in a short space of time so as to require only the minimum of investment in equipment. There is a saving to be had from reducing the number of times that the fires are dumped and the number of points at which round-house and terminal forces must be maintained, and the longer the runs the less will be the loss of time by trains in changing engines. The principles which are carried out in marine practice, in which machinery is kept working as continuously as possible, seem to apply equally well in locomotive work, and the reasons are easy to understand. Machinery needs no rest, and if idle longer than time sufficient to properly care for it, a waste occurs.

The discussion of the length of locomotive runs is also productive of good in calling attention to matters with which the actual operation of the engines has nothing to do, such as the unnecessary switching of trains and the changing of cabooses in the case of freight trains, this having been found to be an item of more importance than was realized. It is, perhaps, true that more credit for economical improvement is given to increased length of runs than properly belongs to it, because of the fact that several leaks have been concealed under the changing of engines. It was thought necessary to change engines frequently, and advantage was taken of the stops thus caused in order to do a lot of odd jobs with the trains, such as switching, iceing and watering the cars. The elimination of the changes at various points frequently carries other important advantages in its wake and the result is a decided saving, as it is the sum of direct and incidental improvements.

It is necessary to be temperate in estimating the value of any such improvement, exaggeration of which is likely to mislead, and a very excellent opportunity is offered, by the suggestion of a change in practice, to look over previous practice to see that all the available good results have been squeezed out of the old before adopting the new. Many of the incidental advantages attending long runs ought to be enjoyed any way, even if the longer runs were not made a consideration. It is stated, for instance, that great savings may be made by reducing the number of yard masters, switch engineers, train despatchers and other similar employees, owing to the reduction of the number of locomotive terminals. The system is wrong if the changed locomotive runs leads to any such reduction. It is held by a contemporary that an improvement of about 25 per cent. may be expected from the institution

of long runs. This is believed to be unreasonably high. The saving in coal may be a measurable item, and it may not because of the difficulty introduced by the dirty fires which are incident to long continued running. Nothing will be saved in the wages of engine crews unless the previous runs were too short to give the men the daily allowance of mileage. The actual engine mileage may not be increased by the change, but it is clearly possible to increase this factor by turning engines about over short runs. There will, however, always be a saving in the terminal expenses for such help as wipers and hostlers. The plan is evidently good and without doubt will be the means of effecting a great saving, but an improvement amounting to 25 per cent. is not to be expected except where something is radically wrong with the old methods. There are obvious advantages in long runs aside from the possible increase in mileage, but large mileage is to be sought for even if special conditions prevent the changing of locomotive terminals and the extending of runs.

RAILROAD TESTING BUREAUS.

The advisability of establishing testing stations supported by the railroads was suggested at the recent Master Car Builders' convention, and that of installing routine and research laboratories under the control of the Master Mechanics' Association was mentioned at the convention of that association. The subject of railroad testing laboratories has been a favorite one with the associations for nearly twenty-five years, and in 1874 at the Chicago convention of the Master Mechanics' Association, a committee reported upon a general laboratory scheme, and after a discussion which now seems amusing, the matter was laid over until the following year, when it was dropped because a majority of the members opposed drawing from the funds of the association for such a purpose. It was a good thing to drop, because it embraced a scheme for a traveling laboratory fitted up in a car for convenience in serving the interests of roads in different parts of the country. Since that discussion was held so many new features of railroad engineering practice have appeared that it seems altogether advisable that the side of the question referring to a research laboratory should be revived.

The most successful roads are now nearly all equipped with laboratories, and that these features of railroad organization have not been cut off during times of business depression is good ground for maintaining that they are now accepted as necessary to business-like management. Many of the small roads cannot afford to establish and maintain laboratories of their own, and it was partly in the interest of these that the subject of testing bureaus was introduced at Old Point Comfort.

Laboratory work is divided into two distinct parts, the routine work of checking up specifications by ordinary tests and the pursuit of original research. It would be comparatively easy, if it is advisable or necessary, for the two associations to combine in a scheme looking to the establishment of a number of testing stations in large railroad centers, to which samples of material could be sent by roads represented, the expense perhaps to be defrayed by charges for work actually performed for each road. It would seem perfectly natural and logical to go a step further and establish a general testing station for the conduct of more elaborate work in the line of research. The expense of a well-appointed dynamometer car or of a stationary locomotive testing plant is too much for more than a few of the strongest roads, and the cost of operating either of these is so heavy that only one or two roads can see their way clear to undertake exhaustive tests thereon. The fact that the Master Car Builders' Association has more money in its treasury than it knows what to do with, and that the other association might easily be in the same condition financially, is suggestive of a possible way of providing for the expense of a joint research laboratory, and the railroads should assist in such a matter.

The advisability of establishing laboratories for routine work by these organizations is however open to question. In the first place, it should be asked whether they are needed. The large roads are equipped with testing machines, and it is doubtful whether those not having them would furnish enough work to permit of paying expenses under a plan such as has been suggested. While such concerns as the Pittsburgh Testing Laboratory offer satisfactory facilities for testing materials used by the railroads, it seems unnecessary for the associations to undertake to equip and operate ordinary laboratories. Good and complete equipment should be employed, which ought to include chemical as well as physical apparatus and the necessary attendance for both. This would be expensive, it would not be needed by all the roads, and it would seem as if the associations would put themselves out of their element to undertake the operation of such plants.

There are no reasonable objections which can be thought of by the writer to a scheme for founding a general research laboratory for such work as is now done by the railroads with which the chairmen of the various committees happen to be connected, and it would appear to be a matter upon which joint action of the two organizations might properly be taken. It is manifestly unfair to expect any railroad to volunteer to shoulder the expense of an elaborate series of tests such, for instance, as are required in investigatons requiring the use of a stationary testing plant, especially when the competitors of the road having the plant are to get equal benefits. While some roads are sufficiently magnanimous to offer the use of equipment and men for the benefit of the associations, this should not be expected. If a committee reports recommendations with regard to the best arrangements for exhaust nozzles and other front end attachments, and a number of roads try the plan and save some 10 or 20 per cent. or even more than that in the fuel consumed by locomotives as was done last year, why should not these roads contribute to the cost of the tests?

As already stated, this idea is not by any means new, but it is more appropriate now than ever before, because with the advances which have been made in methods of conducting investigations, the expense has increased and so also, in a corresponding ratio, have the results of research become more valuable. It was clearly shown at the last conventions that the most important reports are those which are based upon service tests and a suggestion of a general thoroughly equipped laboratory better than any one railroad can afford to establish seems to be a proper one. Such a laboratory could be placed at the disposal of committees and would give them opportunities which are not now available. One of the reports of the last Master Mechanics' convention closes with the following paragraph, which indicates the opinion of that committee upon the subject of exhaustive tests:

> While the results obtained from these tests are very interesting, and may be said to be conclusive for a locomotive of the type used and under the conditions under which the tests were made, your committee feels that sufficient information has not been secured to enable them to answer conclusively the question propounded, and believes that to do so will necessitate making a series of tests with the different types of engines for which the information is desired under different conditions as to gage of track, degrees of curvature, etc., and if the association feels that it is desirable to pursue this investigation further, that it would be advisable to set aside a sufficient amount of money to defray the expenses of making such tests, as the expense incident to making such elaborate tests will be considerable, and it would not be right to expect any railroad company to make them at its own expense.

NOTES.

The recent extension of the Liverpool Overhead Railway and the increased size and service of trains have necessitated an enlargement of the power-station plant, and two additional boilers, engines and dynamos have been installed.

The next road which will probably consider the use of electric traction for surburban service is the Boston & Albany, and the Newton circuit line will present a favorable opportunity for such a change when the work of grade crossing elimination is completed.

In discussing the application of electric motors in machine shops before the American Society of Mechanical Engineers at the Hartford meeting, Mr. W. B. Smith Whaley said that in two cotton mills containing the same amount of machinery, one driven by shafting and the other by electricity, the former required 530 and the latter 450 horse-power to drive them.

A new ship law has been passed by the Russians which makes it necessary for all trade between all Russian ports of the Baltic and the Black Sea and the Pacific coast by sea to be carried on in Russian ships, and under the Russian flag. The new law goes into effect in 1900.

The preliminary trial of the torpedo boat *Dupont* was made July 7, at Newport, R. I. Under a steam-pressure cf 225 pounds on three boilers and with 420 revolutions per minute of the engines a speed of 30.83 knots was recorded. The official trial is expected to show much higher speed.

In one of the discussions at the recent meetings of the American Society of Mechanical Engineers the statement was made by Mr. A. C. Woodward that it would cost no more to equip a new shop with electric motors for driving the machinery than it would for the shafting and accessories usually employed.

The steam yacht *Ellide* in her second speed trial over a measured course is reported to have made a mile in one minute and thirty-eight seconds, which is at the rate of thirty-six and one-half miles per hour or within a mile and a quarter of the speed attained by the *Turbinia*. The *Ellide* is only 80 feet long, and the high speed is a result of special designs of hull, boilers and machinery.

In the annual report of the Southern Pacific Company recently published are some interesting figures as to the result of creosoting lumber. Figures are given of the diminished cost of maintaining timber trestles since they have been renewed with creosoted lumber and ballasted floors. In 1891, when the effect of these renewals had become apparent, the cost of maintaining the timber trestles on the Atlantic properties was $1.212 per lineal foot. This fell to $0.953 in 1893, and in 1896 it had fallen to $0.346.

Professor Sweet's idea of a good basement floor for a machine shop, on damp but solid ground, as expressed at the recent meeting of the American Society of Mechanical Engineers, is a layer or two of thin flat stone, bedded in concrete, and then a thin coating of concrete, to give the total depth of 6 inches, a coat of asphalt to keep out the moisture and a layer of 2-inch plank, covered by a top flooring of ⅞-inch stuff 5¼ inches or less in width, cut into 4-feet lengths to facilitate repairing, breaking joints with every course.

Encouraging employees to make efforts to perform their duties properly undoubtedly pays, and the marked success of premiums in street railway service in New York is interesting. President Vreeland, of the Metropolitan Street Railway Company, of the city mentioned, states that more than 200 men are now receiving an extra compensation of 25 cents per day because of no complaints having been made against them by officers or patrons of the company for a year past. The number is stated to be growing.

Compressed air has been applied to the pumping of water in England in a new way, recently described in *Engineering*. The power is supplied by a gas engine, which drives an air compressor, the discharge of which is led alternately to two closed vessels. During the time that the air is being forced into one of them, the other is being filled with water, which is in turn forced out by changing over the flow of the compressed air. The change is made automatically. The capacity of the plant, which is at Haverhill, Suffolk, is 18,000 gallons per hour from the wells into the settling tanks, and 10,000 gallons per hour into the high-service reservoir.

In commenting upon the representative ship sent by the United States to the recent naval review, in connection with the Diamond Jubilee celebration, *The Engineer* says: "The *Brooklyn* focused the gaze of each observer present. Our engraving, which is taken at an excellent angle for showing her idiosyncracies, illustrates the appearance of her three huge funnels, and diminutive fighting towers, also her great freeboard forward, and the 'tumble-home' of the sides at the waist. The scattered gun positions stand out boldly; but their proximity to one another on the broadside would seem to indicate a possible danger of the fire of adjoining guns fouling one another. At the same time it was felt by many experts that she would be an awkward enemy to tackle, and that she could give and receive many a hard knock."

In *Le Genie Civil*, May 1, 1897, J. De Rey Pailhade proposes a new division of the day on the decimal system. He divides the day into 100 parts, and each of these into 100 other parts, calling the unit the cé, and consequently the other divisions decicés, centicés millicés, dimicés, etc. The equivalence to the present system is shown as follows:

1 cé		14	minutes,	24.0	seconds.
10 "	2 hours	24	"	00.0	"
1 centicé		0	"	8 6	"
5 "		0	"	43.2	"
10 "		1	"	26.4	"
25 "		3	"	36.0	"
50 "		7	"	12.0	"
1 millicé				0.864	"
1 second				1.157	millicés.
1 minute				69.444	"

The Seaboard Air Line is engaged upon a novel and sensible scheme for promoting the development of agricultural interests along its lines, which consists of a train carrying an exhibit of agricultural implements and machinery for the purpose of instructing farmers in methods of improving their condition. The machinery is accompanied by representatives of the manufacturers, and considerable attention is given to the matter of good road construction. The smaller details, such as fruit drying and dairy operations, are given a good share of attention with a view of making the country as productive as possible. The party includes a representative of the Agricultural Department of the United States, and is under the direction of Mr. John T. Patrick, Chief Industrial Agent of the Seaboard Air Line, whose office is at Pine Bluff, N. C.

The rapid transformation of the White Star liner *Teutonic* into a cruiser for the recent Diamond Jubilee celebration at Spithead has attracted wide attention. Thirty hours saw the change completed under supervision of a British naval officer. The machinists and carpenters of the White Star line were put to work transforming the *Teutonic* into an armed cruiser the moment she arrived at Liverpool on her voyage from New York. Her decks, where the guns were mounted, were sheathed with 4-inch teak, and a lot of stanchions were set up between the spar deck and the saloon deck to strengthen the latter deck. The rails of the ship were pierced to give some of the 16 4.7-inch rapid-fire guns a chance to play. Two of these guns were mounted on the forecastle head and two on the after turtleback. The others were placed in various parts of the ship. Eight four-barrelled 1-inch Nordenfelds were mounted on the saloon deck.

According to the official report of the Minister of Commerce for Hungary on the operating roads in that country there were in 1894 18 roads having a total length of 108,157 miles. In 1895 there were 19 roads operating having a total length of 110,275 miles, divided into:

Animal traction	59,776	miles.
Locomotive traction	34,143	"
Electric traction	16,355	"

Equipment:	1894.	1895.
Horses	1,751	1,763
Locomotives	24	24
Cableway engines fixed	2	2
Cars run by electric motor	92	98
Passenger cars	542	542
Freight cars	101	101

The Budapest electric roads gave the most satisfactory financial returns, 13.64 per cent. in 1895 and 7.11 per cent. in 1894 of the capital invested. The mean earning was 9.15 per cent. in 1895 as against 6.46 in 1894. Four new lines were under construction in 1894, all electric, of which two were located at Budapest.

The scheme favorably reported upon recently by a special commission to the Dutch government, contemplates the drainage and reclamation of the land now covered by the Zuider Zee which is upward of 1,500 square miles in extent. The means proposed to

accomplish the purpose are simple, and consist in the construction of a dam or dyke across the middle of the Zee, and ultimately joining the peninsula near the island of Urk, in North Holland, to Kempen, in Friesland. The completion of this dyke, which would be about 100 feet wide at the base by 20 feet in height, would convert the Zuider Zee into a lake, from which the water would be pumped. The construction of the dyke would take nine years, while the entire work of reclamation would occupy a generation. The estimate of the commission is that the entire work can be executed for the sum of 130 million dollars, while the value of the land to be recovered is assessed at 185 millions.

Hydraulic forging is continually making friends among steel and iron workers. Recently President Martin, of the Iron and Steel Institute (England), commented upon the advantages offered by the press over the hammer. He said in effect:

The press treats the material to be forged, especially steel, in the best possible way, the mass even to the center being worked and kneaded by it. Recently, at Dowlais, a very disagreeable reminder was had of what the interior condition of large masses of iron may be. The shaft of one of the drums at the Bedlinog Colliery, having a length of 27 feet between the bearings and 1 foot 9 inches in diameter, broke after working 18 years. On examination the interior showed that the scrap iron from which it had been built up had practically never been welded in the center—whether it was due to its not having been properly heated, or to perhaps too light a hammer having been used in its forging, could not be determined; but the portions of the fracture showed that the iron forming the interior of the mass had never been either properly worked or welded.

Coke is extensively used in German stationary steam plants as is shown by a paragraph in the *Foreign Abstracts* of the Institution of Civil Engineers. According to the report of a Prussian Royal Commission on Smoke-Consuming Appliances, none of the systems they examined gave perfect smokeless combustion of coal. Where smoke is objectionable, coke is used. The coke consumption on the Prussian railways increased from 24,940 tons in the year 1844 to 182,000 tons in 1858. The high price and irregular supply of coke led to the use of a mixture of coal and coke, and consequently, in the years following 1858, the coke consumption steadily decreased, until, in the official year 1894-5 only 65,250 tons were used on the Prussian railways. Its consumption in stationary boilers has, however, increased rapidly of recent years; 7,900,000 tons being the total consumption throughout Germany during 1894, an increase of 11.1 per cent. over that for the preceding year.

The Philadelphia Fire Underwriters' Association has decided to grant permission for the use of acetylene gas in liquefied form under pressure for lighting purposes, provided that the pressure of gas on the piping in the building to be assured shall at no time exceed one-quarter pound per square inch, and that the cylinder containing the liquefied gas under pressure and all-pressure reducing and safety devices be located outside of such building, and in a separate building well ventilated to the outer air, but of sufficient strength to protect the apparatus from outside interference and from the weather (especially the sun's rays); and that the supply pipe for the building be provided with a hand valve just inside of the building assured, so that the gas may be entirely shut off from such building. It is also provided that the cylinder containing the liquefied gas under pressure shall be equipped with a safety valve to protect against both excessive pressure and unusual increase of temperature, and that both the pressure-reducing and the safety (mercury) valves shall be provided with vent pipes opening into the outer air; and that no acetylene gas or calcium carbide shall be stored on the premises.—*Journal Franklin Institute.*

Recent occurrences in Europe have brought out very clearly the growing use of electricity in warfare. According to *The Electrical Engineer* naval experts at Kiel have been testing the practical uses of dragon-shaped airships or balloons, which may be put on board vessels for use during naval engagements and in reconnoitering. Some of the balloons rose 5,500 feet, remaining fastened to the decks of torpedo boats, which were steaming 18 knots an hour, enabling the balloonists to make valuable observations of the stations of vessels at a great distance. The observations made were communicated by telegraph or telephone from the balloons to persons on the decks of the vessels below, enabling them to change the course of the latter accordingly. At the recent British jubilee naval review the United States man-of-war *Brooklyn* received great attention, and Mr. Laird Clowes, the naval expert, declared that, as proved by the new ship, England is in the resort to electricity many years behind the United States. That she will remain so is seriously open to question, but credit for our leadership is welcome and must be ascribed to the patient and brilliant work of such men as Lieut. B. A. Fiske, who may be said to be devoting their lives to this subject, in behalf of our navy.

The sea-going qualities of monitors have often been questioned, but that the *Puritan* behaved well on a recent trip from Charleston, S. C., to New York there can be no doubt. Captain Bartlett said in his report of the trip: "By 6 o'clock it was blowing a fresh norteasterly gale, with a heavy sea, and although the ship behaved admirably, rolling easily and rising buoyantly. . . . "As I have already stated, the ship behaved admirably in the heavy sea off Hatteras. Her roll is not quick, and she recovers easily and without straining. As was to be expected, while pitching very little, she takes great quantities of water on board, the waves dashing violently against the turrets and superstructure and throwing spray over the pilot-house and bridges. In my judgment, it would be possible to fight the guns in almost any weather, though not without taking water through the turret ports. In moderate weather she would afford a reasonably steady gun platform, owing to her steadiness and slowness of roll. . . . "To-day I inspected the vessel, and notwithstanding the heavy weather of yesterday, with the exception of slight leaks around the armor shelf, which were in existence when she went into commission, and a very slight leak in the executive officers' state-room at the base of the superstructure, I could find no defects."

No official figures on the consumption of petroleum for fuel have been published since the statement presented in the columns of the *Shipping and Commercial List* on Jan. 17, 1894. Then it was shown that the Ohio and Indiana oil fields had furnished for fuel purposes 7,000,000 barrels crude in 1890, a trifle over 9,500,000 in 1891, about 11,000,000 in 1892, and 9,000,000 in 1893. The consumption dropped to 8,000,000 barrels in 1894, and last year the total sales of fuel were 7,600,000 barrels. Since Jan. 1 the movement of crude for that purpose has continued at about the same ratio. The decline is owing to reduced production and higher prices. In 1892, when consumption was at its highest point, and producers were pushing the use of oil for fuel, the cost of Lima oil at the wells was 15 cents per barrel, in comparison with 73 cents as the average last year. The decreased yield of Pennsylvania crude compelled refiners to give more consideration to the so-called Lima oil. By improved processes they brought the Ohio refined to perfection, and it is now as acceptable for export as any other grade of petroleum. For that reason much less crude is used for fuel, and unless production should largely increase, the volume of business in fuel oil will continue to decrease, so far as the Ohio and Indiana fields are concerned. A different story comes from California, where the production last year was 800,000 barrels, against 400,000 in 1894, half of which was used for fuel and the balance refined. Developments are rapidly increasing the oil wealth of that State, and until the oil is otherwise used great efforts are being made to push it forward as a fuel. It is now being used in locomotives with success, this feature being taken from Russia. The comparatively new fuel is meeting with favor on the Pacific coast, as it cheapens the cost materially to many industries.—*Scientific American.*

Consul Read writes from Tientsin, China, April 17, 1897: "A few days ago the Imperial Railway opened for traffic another 40 miles of railroad beyond Shan-hai-Kwan, along the Liaotung Gulf, in the direction of Kin Chou. The terminus of these 40 miles just opened is at Chung-hou-so, on the Lu Chou Ho. The total length of the railway from Tientsin to Chung-hou-so is nearly 214 miles. The line from Tientsin to Peking is within a few miles of Peking and will be opened to the public shortly. The Tientsin-Peking extension will add another 80 miles to the present 214 miles in operation. Mr. Kinder informed me that the survey of the Peking-Paoting-fu extension had been completed, and that the throwing up of embankments would soon be begun. This Peking-Paoting-fu extension will add another 80 miles to the system."

The refuse destructor plant at Shoreditch, England, was opened June 28, by Lord Kelvin. The works were established by the municipality and are designed to destroy the local refuse, generate electric light, and supply hot water to the public baths and laundries. Carts will convey the street, trade and household refuse to the works, where motor cars and electric hoists will distribute it to tipping platforms. Hence it will be shot by the aid of mechanical feeders into a dozen cells of the destructor. A forced draught is provided by motor-driven fans, some of which will exhaust an adjacent sewer and blow the gases therefrom into the furnace to help feed the flame. Steam generators and boilers will be used to drive the engines and dynamos and to heat the water to be furnished to the baths and laundries. It is expected that 20,000 tons of refuse a year, which has formerly been carried out to sea at great expense, will be consumed annually in this plant. Lord Kelvin, in opening the works, described the project as an extremely happy union of scientific knowledge and mechanical skill, and said that it required remarkable courage in its application in this initial plant.

The water-tube boiler was endorsed in a paper by Rear Admiral Fitzgerald recently read before the Institution of Naval Architects. The Bellevile boiler was the type upon which the observations were based and the experience was obtained on the *Powerful* and *Terrible* as well as on several smaller vessels. These boilers possessed marked advantages in point of rapid steam raising, ability to make large and rapid increases of speed and correspondingly rapid decrease without blowing off at the safety valves, comparative safety, facility for examination, cleaning and repairs, and saving of weight. As to the rapidity of steam raising, the *Sharpshooter*, a 735-ton gunboat raised steam in 20 minutes from cold water and "fires out"; with the old form of boilers the time required would have been from two to three hours. The rapidity of increasing the power enables a large ship to be started off nearly as quickly as a small torpedo-boat. The safety from explosion is greater because while one of the boilers of the *Powerful* holds a ton of water, each of the boilers of the *Majestic* holds 22 tons. The water-tube boiler is rendered accessible because it may be quickly cooled without injury to seams and plates. An idea of the saving in weight may be obtained by comparing the weight of the boilers and uptaker of the *Powerful* at 1,164 tons with that required for Scotch boilers, which, for the same power, would weigh 1,862 tons, a saving of nearly 40 per cent. for the water-tube boiler. These comments are from the standpoint of a naval officer who has to fight the ship.

Fast Run on the New York Central.

A trip made by train No. 51, the Empire State Express, on the New York Central & Hudson River Railroad, July 16, deserves to be chronicled among the great achievements in the direction of fast running. The time for the distance has been surpassed, but in this case absolutely no preparation was made for extra fast time and the work was done by the locomotive runner in an effort to make up lost time and bring his train to its destination on time. The run was between Syracuse and Buffalo, the train having been delayed so as to be 23 minutes late at the former station. Twenty-one minutes were made up in the run of 149 miles and the train was only two minutes late at Buffalo, the time for the distance, stops and slow downs not deducted, being 143 minutes or an average speed of 62.6 miles per hour.

The train consisted of a cafe car, two coaches and a drawing-room car weighing together 374,000 pounds not including passengers and baggage, The engine was No. 903, built in 1892 by the Schenectady Locomotive Works to designs and specifications by Mr. Wm. Buchanan, Superintendent of Motive Power and Rolling Stock of the road. The engine is of the eight-wheel type, burning bituminous coal. The cylinders are 19 by 24 inches, the drivers are 78 inches in diameter, and the weights are as follows: On drivers, 81,400 pounds; on truck, 44,750 pounds; total, 126,150 pounds. The total weight of the engine and tender in working order is 200,000 pounds.

It will be interesting to compare this performance, which was not prepared for, with some for which every facility was given for fast work. The highest average speeds for runs of more than 100 miles in the record-breaking trip on the Lake Shore & Michigan Southern in 1895 were 64.25 miles per hour for the Air Line division of 133.4 miles and 62.18 miles per hour for the Toledo division of 107.8 miles, but the recent New York Central run is not reckoned by the time while running only, because of necessity the speed must be taken from the start to the finish without deducting lost time, for the simple reason that there were no timers present and no one knows accurately the exact amount of time which was lost. This run was made in the ordinary course of business and it appears to be a case admirably confirming the belief that marked improvements are being made in the facilities for every-day fast long-distance travel. Encouragement should be offered to roads upon which the men handling the trains take such interest in punctuality.

Some Great Liners.

Apropos of the gigantic Atlantic liner which is under construction for Messrs. Ismay, Imrie & Company, of the White Star Line, at the Queen's Island yard of Messrs. Harland & Wolff, Belfast, it may not be out of place to give a few particulars in regard to the two rivals of the *Oceanic*, which have been building during the past twelve months at the Vulcan Shipyard, Stettin, and at Herr Schichau's, Dantzic, for the North German Lloyd Company, but which are now quite eclipsed by the Irish boat. We have added to our tabular statement of dimensions, etc., a few figures descriptive of the characteristics of the *Great Eastern*, and embodied the whole in a comparative form, which indicates very plainly that the old Leviathan—as she was named at first—has yet to be beaten in point of displacement or actual size.

The beam of the *Oceanic* we have estimated by taking a similar proportion of the length to that which is found in the most recent liners built for the White Star Line. The draught is an arbitrary factor, and has been fixed by us, for the sake of comparing her with the German twin vessels, at 26 feet. The draught of the Great Eastern was ordinarily, we believe, about 2 feet more. The various features are as follows:

	N. G. Lloyd's Liners.	*Oceanic.*	*Great Eastern*
Length between perpendiculars	625 feet	680 feet	680 feet
Length over all	645 "	704 "	697 "
Beam..............................	66 "	72 " (?)	83 "
Draught............................	26 "	26 "	28 "
Moulded depth	43 "	— "	— "
Displacement......................	20,500 tons	24,349 tons(?)	32,160 tons
Gross tonnage	13,700 "	17,000 "	22,000 "
Horse-power, indicated............	30,000 "	45,000 "	2,700 nom.
Speed..............................	23 knots	27 knots	12 knots
Number of propellers...............	2	3	1 & padls.
Co-efficient of fineness, estimated..	.67	.67 (?)	.71

The co efficient of fineness of the *Oceanic* we have estimated as probably about ·67, for although her speed is to be far higher than that of the German vessels, as a rule co-efficients are rather more bluff in British vessels than in foreigners. It will be noticed that the ratio of beam to length in the *Great Eastern* was far higher than that maintained in modern liners, being $\frac{2}{17}$ instead of $\frac{2}{19}$. The reason of this was because an agitation set in about the year 1854 against the knife-like lines which were becoming characteristic of our ships at that time. It was not unusual then to find vessels proposed with a proportion of beam to length as 1 to 12! It is somewhat singular to find that our shipbuilders are again approaching the ratio of 1 to 10. So far as we know, however, no modern liner has hitherto gone beyond this limit.—*The Engineer.*

Books Received.

MINUTES OF CONVENTION OF EMPLOYEES OF THE BRIDGE AND BUILDING DEPARTMENT, CHICAGO, MILWAUKEE & ST. PAUL RAILWAY. 134 pp., paper, standard size (6 by 9 inches). Chicago, 1897.

This pamphlet records the proceedings of the meeting of a technical organization formed among the assistant engineers, bridge inspectors, district and chief carpenters of the Bridge and Building Department of the Chicago, Milwaukee & St. Paul Railway. This organization was started several years ago for the purpose of enabling the members of the bridge and building staff of the road to study and discuss questions relating to their work. The subjects are presented in the form of brief papers, which are discussed by the members. Among these the following subjects indicate the character of the work done. "Economy," by Onward Bates, Chief of the Department; "Co-operation Among Department Subdivisions," by G. W. Smith; "Water Supply for Locomotive Use at Stations," by H. A. Schumacher; "Construction of Buildings," by J. U. Nettenstrom; "Waterways," by A. G. Baker; "Material of Construction," by W. A. Rogers; "Life of Wooden Bridges," by E. S. Meloy; "Method of Erecting Iron Bridges," by E. Greenwald; "Our Iron Bridges," by A. Reichman; "Notes on Masonry Construction in 1896," by W. A. Rogers, and "Office Work," by W. W. Christie. These subjects are presented by the men who have charge of the various departments represented, and while the treatment is intended to benefit those upon that road, there is much to be learned from the paper by an outsider. The most commendable feature of the publication is the fact that it is a result of the liberality of the management of the road and of the head of the department in providing admirable means for encouraging and instructing the men in charge of the bridge work. There has been no bridge accident upon this railway system in seventeen years, which is a record to be proud of.

TABLES FOR EARTHWORK COMPUTATION. By C. F. Allen, M. Am. Soc. C. E., Associate Professor of Railroad Engineering, Massachusetts Institute of Technology. Cloth; 6 by 9¼ inches; pp. 38. New York: D. Van Nostrand Company. $1.50.

The tables presented in this book were compiled for the use of railroad engineers in the computation of earthwork, the operations being exceedingly laborious and unsatisfactory without diagrams or tables. The table form is much more convenient than diagrams for field use on account of the compactness of the figures and the superior accuracy of the results. Table I. is adapted for rapid computation for sections of any base or slope, and for irregular and regular sections. Results are readily obtained by the use of Table II. that are correct by the "Prismoidal Formula." In Table III. provision is made for very rapidly taking out quantities for level sections when the center heights alone are given; in making preliminary estimates there is need for such a table, and a limited number of the most common bases and slopes are provided for. The preface states that great care has been taken to make the tables strictly accurate, and that no errors are known to exist. The author requests that any errors found shall be brought to his attention. The letterpress, binding and arrangement of the work are good, and the type in the tables is well selected.

TRANSACTIONS OF THE ASSOCIATION OF CIVIL ENGINEERS OF CORNELL UNIVERSITY. Vol. V., 1896-1897. Containing addresses by non-resident lecturers, miscellaneous papers, constitution and list of members of the association. Ithaca, N. Y., June, 1897.

The most noteworthy of its lectures is that which was delivered before the College of Civil Engineering by Mr. Charles Hansel, M. Am. Soc. C. E., entitled "Progress in Signal Engineering." The address fulfills the promise indicated in the name and is the best of recent discourses upon the subject. The illustrations present a number of important improvements in signaling apparatus.

VOCABULAIRE TECHNIQUE DES CHEMINS DE FER. By Lucien Serraillier. 222 pages. Published by Whittaker & Company, 2 White Hart street, London, and The Macmillan Company, 66 Fifth avenue, New York, 1897. Price, $3.

This is a railway technical vocabulary with French, English and American terms, and at its close are 22 tables for the convenient conversion of the terms of money, measures, weights and temperatures used in the countres mentioned. The book fills a long-felt want, and it is one that many engineers and railroadmen have needed because of the great difficulty found in obtaining translations of technical terms and expressions contained in engineering literature. It will be a Godsend to translators, and it should be found upon the shelves of every engineer who pretends to keep up with foreign practice. The fact that the business of railroading is comparatively modern, and that words have been coined to fit the needs, and that this has been done independently by the various countries has caused the confusion of terms which renders it difficult to understand engineers who write in other languages. The author in his preface suggests the need of international nomenclature which shall give the technical equivalents of these terms in each language, and thus save the time and labor often involved in looking up special text-books for many terms which may occur in foreign literature or in the course of the annually increasing business dealings between home and foreign railroads. He expresses the hope that some understanding will be ultimately arrived at by which a process, operation or appliance shall be known by one name only in each language, so as to avoid the confusion and uncertainty which often arise when various expressions, denoting the same object, are adopted by different railroads in the same country. The general employment of the fundimental ideas embodied in the Car Builder's Dictionary is needed, only it should not be confined to any one brand of the railroad subject. The author has been mindful of this idea in compiling this vocabulary confining himself to French, English and American terms. He has used a number of authorities, of which a list is given at the close of the work. Among them are well known books such as Railway Car Construction, by Vost, and the Car Builders' Dictionary.

A novel method of classification was followed, in which the terms are grouped according to the subject matter. This was preferred to the alphabetical arrangement, because of the convenience obtained by placing the constituent parts of an appliance under the head of the appliance itself, and synonymous terms are bracketed together, thus avoiding what is often a vague or ambiguous translation when terms are arranged alphabetically. This method of grouping also reduces the size of the book by dispensing with one of its two sections of a bilingual dictionary. Mr. Serraillier invites suggestions and criticisms on the work, with a view of improving future editions, and it is hoped that he will be encouraged to continue the labor which has been so well begun.

The book is divided into seven sections, viz.: "Class of Railroad," "Administration," "Traffic," "Way and Works," "Locomotives and Rolling Stock," general subjects and tables of British and metric measures. The words in each section are grouped according to subjects and sub-subject. For example, "Culvert" is placed under "Masonry and Brick Work," and under the general heading of "Way and Works." As far as possible the parts of any appliance appear immediately under the name of the appliance. The whole book is arranged in double columns with the French at the left, the English and the American terms being at the right of the page. The American terms are distinguished from the English by asterisks, and where terms are common to both countries these are omitted. For example, our "Pedestal" is called "Axle Guard" in England. The word "Pedestal" is marked with an asterisk, and a foot-note is added explaining that this part is called a "Horn Plate" in England, when it refers to locomotives, and "Axle Guard" when it refers to cars.

The arrangement of the terms which was employed may permit consolidating the work, but it would seem possible to facilitate finding the desired terms if an alphabetical order had been followed. The letterpress and binding are excellent, the size of the book (5 by 7¼ inches) is convenient and the work throughout is well gotten up. The book is dedicated to John Clarke Hawkshaw, member of the council of the Institution of Civil Engineers.

BLOCK SIGNAL OPERATION. A Practical Manual by William L. Derr, Superintendent Delaware Division of the Erie Railroad. D. Van Nostrand Company, New York. Cloth, $1.50.

THE author gives general descriptions of the different systems of block signaling, discusses the general principles of blocking and the apparatus employed, gives diagrams of blocks and rules for the government of the various systems. An idea of the work may be obtained from the classification of subjects as follows: General principles, block signals, signal lamps, block towers, signal bells, block records, train orders at block stations, blocking at junctions and crossings, manual blocking, controlled manual blocking, automatic blocking, and machine blocking. The only original matter presented in "A Method of Single-Track Blocking" described in connection with manual blocking. This system embodies features to insure the holding at the proper passing sidings of trains to be met by opposing trains. The purpose of the book is to present the latest American and European practice in block signal operation. Under the heading of Automatic Blocking, the author gives brief descriptions of the Union and the Hall systems with rules which are in use on the Pennsylvania, Lake Shore and Illinois Central Railroads. The book is a valuable one for signal engineers by

whom it whom it will be found convenient for reference. It will also be found useful by those who are studying the subject of signaling. It is well printed and bound, and the diagrams while small are clear. It is furnished with an index.

PROFESSIONAL PAPERS OF THE CORPS OF ROYAL ENGINEERS. Vol. XXII., 1896.

This book has been received from the Secretary of the Royal Engineers' Institute, Chatham, England. It contains the following papers: Combined Naval and Military Expeditions, by Vice-Admiral P. H. Colcomb; The Defence of Plevna, by W. V. Herbert; Flat-Bottomed Boats, by Lieut. W. A. Watts-Jones; Notes on Suspension Bridges on the Road from Hushmir to Gilgit, by Capt. J. E. Capper; The Forces Made Use of in War and Their Proper Application, by Maj. C. B. Mayne; On Bridging Operations with the Chitral Relief Foree, Official Reports; Notes on Indents for Pipes and other Stores for Water-Works, by Maj. C. D. Courtney.

AMERICAN JOURNAL OF MATHEMATICS. Vol. XIX., Number 3. July, 1897.

Catalogue of the University of Virginia, Charlottesville, Va., catalogue for 1896-1897, and announcements for 1897-1898.

Catalogue of Knoxsville College, Knoxville, Tenn., 1896-1897.

McGill University, Montreal. Announcement of the Faculty of Applied Science for the Session of 1897-1898.

Trade Catalogues.

[In 1894 the Master Car-Builders' Association, for convenience in the filing and preservation of pamphlets, catalogues, specifications, etc., adopted a number of standard sizes. These are given here in order that the size of the publications of this kind, which are noticed under this head, may be compared with the standards, and it may be known whether they conform thereto.

It seems very desirable that all trade catalogues published should conform to the standard sizes adopted by the Master Car-Builders' Association, and therefore in noticing catalogues hereafter it will be stated in brackets whether they are or are not of one of the standard sizes.]

WESTINGHOUSE STEAM ENGINES.

This is an attractive 44-page pamphlet describing and illustratthe "Standard" and "Junior" types of Westinghouse engines. The methods of testing the engines are explained and statements as to their economy in operation are given. Among the illustrations are a number showing power stations equipped with these engines.

SWITCHES AND FROGS. Catalogue of the Ramapo Iron Works of Hilburn, Rockland County, New York. 28 pages, illustrated. (Not standard size.)

This catalogue illustrates and describes the product of the switch and frog department of these works and the high class of the appliances is well known. The parts of track equipment shown are well tried and have been found satisfactory, though work will be executed to special designs which may be submitted. Separate catalogues of switch stands, cars or brake shoes are also furnished on application. This pamphlet shows plans of split switches and the stands with tie bars and other attachments therefor. Frogs-yoked, bolted and spring rails are shown and considerable space is given to crossings and slip switches. The latter part of the pamphlet illustrates ground levers, switch rods and equipment for stub switches. Diagrams are presented with directions for ordering switches, frogs and fittings. The letterpress and engravings are good. The frontispiece is a view of the works at Hilburn, N. Y.

CATALOGUE OF THE GOULD COUPLER COMPANY. 1897. Standard size (9 by 12 inches). 76 pages. Bound in leather; illustrated.

This catalogue is enlarged and revised and contains illustrations and descriptions of the new devices which have been introduced by this company for the equipment of cars and locomotives for improving the safety and economical maintenance of rolling stock. This company has recently erected a new steam forge at Depew, N. Y., giving modern and improved facilities for manufacturing its specialties. With the malleable iron and forge works at Depew and the steel works at Anderson Ind., the concern is well equipped for the manufacture of safety devices and the catalogue gives an extended view of the various parts of railroad devices produced.

The works themselves are first illustrated and described and the departments enumerated with a statement of the size of the various buildings. The daily capacity of the works in three important items are as follows: Couplers, 700; vestibules, 20, and platforms, 20. The engravings comprise half-tone reproductions from photographs of the works and of special parts of equipment furnished, such as complete couplers and vestibules, and wax process engravings of the working drawings of many of the devices. The binding, paper and letterpress of the catalogue are excellent, the wax process engravings are good, but some of the half-tone reproductions are disappointing in view of the otherwise very high character of the work.

COMPRESSED AIR AND THE CLAYTON AIR COMPRESSORS. Catalogue of the Clayton Air Compressor Works, Havemeyer Building, New York. Official catalogue No. 9, standard size (6 by 9 inches), paper, 106 pp., illustrated.

This catalogue is the most complete work of the kind which we have received. It contains, in addition to an illustrated description of the features of the Clayton type of air compressor, illustrations and lists of sizes of the standard patterns of compressors, and a descriptive article upon the widening use of compressed air, showing the various applications of this power up to date, together with illustrations and descriptions of compressed air tools and appliances. It also illustrates and explains the Clayton air lift pumping system, which is achieving remarkable results in raising water from wells by means of compressed air. Among the other features of this catalogue will be found valuable data for calculating the loss of pressure due to friction in transmitting air through pipes and the capacity lost by air compressors in operating at various altitudes above the sea level. Air receivers, vacuum pumps, flywheel steam pumps, compresors for carbonic acid gas, compressors for testing under high pressure, etc., are also described. This catalogue is issued for gratuitous distribution and will be forwarded upon application.

The fisherman's paradise is without doubt on the line of the Detroit & Mackinac Railway running from Bay City north along the Lake Huron coast. Its popularity for summer and health resorts is increasing every year among tourists. East Tawas is the door or beginning of the trout streams of northern Michigan, and from here north to Alpena the country is laced with rivers whose waters are of exceptional purity and well stocked with many kinds of fish, such as black bass, rainbow trout, pike and pickerel. Some of the smaller streams are within a short distance from Bay City, and none of them are so far away from Detroit, that they cannot be reached in a few hours of travel. The country along the line is easily accessible to the various streams. A copy of "Do You Fish?" may be had on application to J. D. Hawks, president of the road, Detroit, Mich.

When the New York Central's Empire State Express was first placed in service, one of the chief daily newspapers in London published an article on that event, in which it was stated that the train might possibly run for a few days, but it would be preposterous to suppose that it could be made permanent, as there was "no roadbed in America on which a train could be run at the speed of the Empire State Express for any length of time without shaking the cars all to pieces." After five years of daily evidence that such a train is entirely practicable, our British cousins are now fully convinced of this. It is understood that when the Empire State Express was exhibited in the realistic "biograph" on the stage of the Palace Theater in London the audience showed such enthusiasm as in one case to call the manager of the theater before the curtain, which has happened only twice in the history of the theater. The London *Daily Mail* characterized the exhibition as one of the wonders of the age.

"NOBRAC" is the title of an attractive standard size (3½ by 6-inch) pamphlet published by The Patterson-Sargent Company, of Cleveland, O.

Its purpose is to set forth the advantage of "Nobrac" carbon paints for the purpose of protecting metallic surfaces, and after giving a statement of the requisites of paints for the purpose stated, it presents a number of quotations from well-known engineers on the subject of protecting metal. The pamphlet is well printed and is worthy of preservation.

"1025 MILES IN 1047 MINUTES."

The remarkable run of the Mayham special train over the Burlington line from Chicago to Denver, Feb. 15, 1897, is described in a little pamphlet published by the C. B., & Q. R. R. The record is put in convenient form for filing, and it is worth sending for.

THE ADIRONDACK MOUNTAINS AND HOW TO REACH THEM, No. 20 OF THE "FOUR-TRACK SERIES."

This is a 4 by 8-inch folder, which is full of information of a practical kind. It contains an excellent map of this wonderful region

on the reverse of which will be found a list of hotels, boarding-houses, private camps, lakes, etc., plainly and correctly located on the map by marginal references, and which has been carefully corrected to date. The folder will be found an invaluable aid in arranging a trip to the mountains. It is another good production whereby Mr. George H. Daniels, General Passenger Agent of the New York Central, renders it easy to obtain information which travelers and sportsmen need before starting on a trip through the Adirondacks.

An advance copy of a little book entitled, TWO TO FIFTEEN DAYS PLEASURE TOURS, has just been received from Mr George H. Daniels, General Passenger Agent of the N. Y. C. & H. R. R. R. This is No. 8 of the Four-Track Series of 1897.

It contains information about a series of special reduced rate tours, occupying from 2 to 15 days, arranged for the purpose of meeting the wishes of all classes of travelers, including trips to the Thousand Islands, Montreal, Saratoga, Lake George, the Catskill Mountains, Niagara Falls, Chautauqua, Adirondack Mountains, Berkshire Hills, Richfield Springs, and many other famous resorts. Information concerning these trips is given—distances, time, fares, connections and all other details—with much precision. It contains 12 small route maps, a large colored map of the Adirondack Mountains, another of the lake region of Central New York, and several general maps engraved expressly for this work, and is profusely illustrated with half-tone engravings. A copy of the pamphlet will be sent free, postpaid, to any address in the world, on receipt of two 2-cent stamps, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

AMERICA'S GREAT RESORTS is the title of another of the Four-Track Series, No. 3. All of the leading resorts, both East and West, are represented in this folder, and the rates and time from New York, Buffalo and Niagara Falls, given approximately. It will be found an invaluable aid in arranging the details of a summer trip, and will be supplied upon application to Mr. George H. Daniels, General Passenger Agent of the N. Y. C. & H. R. R.R., with four cents in stamps enclosed.

A standard size (6 by 9 inches) pamphlet of 16 pages has been received from the Pneumatic Engineering Company, of 100 Broadway, New York. This concern is in position to contract for its system of pumping by compressed air, and to furnish pneumatic pumps, hoists and air compressors. It is the sole owner of the patents of Silas W. Tufts, covering a pneumatic system of pumping which is described in the pamphlet. Air-lift pumping is yet new to the engineering world, and its rapid introduction is wonderful, constituting a marked recommendation to those who desire to obtain all of the water that their wells can supply and who desire to concentrate their pumping plants. The users of pumps should investigate this system and obtain copies of the pamphlet. The Halsey pneumatic pump is described and the special advantages claimed for pneumatic pumping are clearly stated.

The Webster Manufacturing Company, whose railroad department is represented by Mr. Chas. F. Pierce, has just published a four-page leaflet illustrating and describing the Webster gas and gasoline engines for railroad pumping stations and other service. Mr. Pierce's address is 1413 Great Northern Building, Chicago.

"A Waste Product and How It is Utilized" is the title of an exceedingly handsome and tasteful little pamphlet issued by the Marsden Company, Drexel Building, Philadelphia, in which corn pith cellulose is described in an interesting manner and the various purposes to which it lends itself are outlined.

The Sterlingworth Railway Supply Company has published a new catalogue of its well-known specialties, which may be had upon application to the offices of the company in New York and Chicago.

Messrs. John Wiley & Sons, of 53 East Tenth Street, New York, announce that a new edition of Circular Catalogue V, containing works on steam engines, boilers, locomotives and steam heating, is ready and that copies may be had upon request.

REVISION OF THE M. C. B. INTERCHANGE RULES. Sstandard size (6 by 9 inch).

This four page leaflet has been compiled by the *Railroad Car Journal*, giving the changes which were made in the rules at the recent convention of the association at Old Point Comfort. The form is convenient for the use of inspectors and others and copies may be had gratis from the publishers.

Personals.

Mr. A. J. Mentor has been appointed Master Mechanic of the Oconee & Western at Dublin, Ga.

Mr. J. Hudson has been appointed Superintendent of the car shops of the Grand Trunk at Port Huron, Mich.

Mr. H. A. Gillis has resigned the position of Master Mechanic of the Norfolk & Western Railroad at Roanoke, Va.

Mr. J. Campbell, Master Mechanic of the Lehigh Valley at Buffalo, has been placed in charge of the car department of the Buffalo Division.

Mr. M. T. Carson, Superintendent of Machinery of the Mobile & Ohio Railway, has removed his headquarters from Jackson' Tenn., to Mobile, Ala.

Mr. Theo. N. Ely, Chief of Motive Power of the Pennsylvania Railroad system, is the recipient of the honorary degree of Master of Arts, which was conferred upon him by Yale University.

Mr. W. S. Hoskins, Chief Clerk in the office of Mr. W. G. Van Vleck, General Manager of the Atlantic system of the Southern Pacific Railway, has been appointed General Manager of the Chattanooga Southern.

Mr. N. Frey, General Foreman of the Burlington & Northern road at La Crosse, Wis., will, until further notice, have charge of all men in the locomotive and car departments. Mr. Frey in all but title succeeds Mr. W. H. Lewis.

Mr. John Dempsey, Master Mechanic of the Central of Georgia at Macon, Ga., has also been placed in charge of the car department at that place, and Mr. S. A. Charpiot, Master Car Builder, has been transferred to the drafting department at Savannah, Ga.

Mr. W. C. Squire, formerly of the editorial staff of the *Railway Age*, is now in the service of the Atchison, Topeka & Santa Fe Railroad as Mechanical Engineer to the mechanical department. Mr. Squire has had a valuable experience in railroad work and is well equipped for his new position.

Mr. Onward Bates, Engineer and Superintendent of Bridges and Buildings of the C., M. & St. P. Ry., has recently had the degree of Civil Engineer conferred upon him by the University of Wisconsin. This title comes to many before they earn it. It comes to Mr. Bates after an extensive, successful and honorable experience.

Mr. Alfred Walter, President of the Delaware, Susquehanna & Schuylkill, and formerly General Manager of the Erie Division of the New York, Lake Erie & Western, was on July 13 chosen President of the Lehigh Valley, to succeed Mr. E. P. Wilbur, resigned. Mr. Walter was General Manager of the Erie from March 1, 1892, to Dec. 1, 1894; and from Aug. 1, 1889, to March 1, 1892, he was General Superintendent of the Baltimore & Ohio lines east of the Ohio River. He was formerly for many years with the Pennsylvania Railroad.

Mr. George Gibbs, who for a number of years has held the position of Mechanical Engineer of the Chicago, Milwaukee & St. Paul Railway, has been appointed to succeed the late Mr. David L. Barnes as Consulting Engineer to the Westinghouse Electric Company and the Baldwin Locomotive Works. Mr. Gibbs has been identified with and has originated many improvements in mechanical and electrical engineering applied to railroads, and is unquestionably better fitted for the important work to which he has been called than any other engineer. Mr. Barnes' successor could not have been more appropriately selected.

Mr. F. M. Whyte has been appointed Mechanical Engineer of the Chicago & North Western Railway, his office being at the West Fortieth street shops in Chicago. At almost the same time that he received this appointment he was elected Secretary of the Western Railway Club. Mr. Whyte is qualified to fill both posi-

tions by a wide and valuable experience in railroad work. He is a graduate of Cornell University and was formerly in the mechanical department of the Baltimore & Ohio Railroad in mechanical engineering work. He was afterward associated with the late David L. Barnes, Consulting Engineer, in Chicago, where he spent several several years in important designing and test work. Among the tests were those of the compound locomotives of the Mexican Central Railway. He assisted Mr. Barnes in the consulting work for the Alley L Railroad in Chicago, and after leaving Mr. Barnes he designed the rolling stock for the Northwestern L in the same city and for some time has conducted a consulting mechanical engineering business there.

Mr. John E. Davidson, Third Vice-President of the Pennsylvania Lines West of Pittsburgh, died at Pittsburgh, Pa., July 11, from the effects of an operation performed July 8 for appendicitis. He was born in Allegheny, Pa., in 1838, and after leaving school entered the service of the Pittsburgh, Fort Wayne & Chicago Railway, as clerk. He remained in the accounting department of that road until he was appointed Auditor of the Indianapolis & St. Louis, at Indianapolis, Ind. He afterward returned to Pittsburgh as Auditor of the Pittsburgh, Cincinnati & St. Louis, and subsequently was made Assistant Comptroller of that road and the Pennsylvania Company. He held this position until 1883, when he was made Treasurer of the same lines, constituting the Pennsylvania lines west of Pittsburgh. April 23, 1891, he was chosen Fourth Vice-President, and in September, 1893, Third Vice-President of the same lines.

Mr. D. W. Caldwell, President of the Lake Shore & Michigan Southern Railway, died at his residence in Cleveland July 21 after a brief illness which until shortly before his death was not thought to be serious. Mr. Caldwell was born in Massachusetts in 1830 and entered the service of the Pennsylvania Railroad as a clerk in 1852. He left that place to become a civil engineer in 1853, and in 1855 was made Superintendent of the Pittsburgh & Connellsville Railroad. In 1859 he was made Superintendent of the Central Ohio Railroad, which place he held ten years until he became General Superintendent of the Columbus, Chicago & Indiana Central Railway. From 1874 to 1882 he was General Manager of several of the Pennsylvania lines. During the last year of the period named he held the title of General Manager of the Pennsylvania Lines West of Pittsburgh. He left the service of the Pennsylvania company in 1882, to become Vice-President of the New York, Chicago & St. Louis, the "Nickel Plate," and after the reorganization of that property became the President of the new company in September, 1887. He held that office until January, 1895. He was elected President of the Lake Shore to succeed the late John Newell in September, 1894. He was also President of the Pittsburgh & Lake Erie at the time of his death.

The resignation of Mr. John F. Wallace, Chief Engineer of the Illinois Central Railroad, is announced to take effect Aug. 1. Mr. Wallace has accepted the office of Vice-President and General Manager of the Mathieson Alkali Works, Providence, R. I. It is a somewhat unusual occurrence for a railroad man, and particularly an engineer of such wide reputation as Mr. Wallace has attained, to leave the field of action in which he has spent so many years and achieved such success in order to take up commercial pursuits. During his six years' service with the Illinois Central Railroad Company, Mr. Wallace has demonstrated that he possesses executive and administrative abilities of the highest order—qualities which in his new position will enable him to manage the large plant which he will have in charge as ably and successfully as he conducted the affairs of the engineering department of the Illinois Central Railroad. Though a young man Mr. Wallace is well known in his profession and throughout the railroad world. When he took charge of the engineering and roadway departments of the Illinois Central Railroad the physical condition of that property was at a very low ebb. He has succeeded in bringing the property up to the first rank among American railroads. All the great improvements that have been made by the Illinois Central Railroad during the past six years have been conceived, designed and executed by Mr. Wallace; and he has made his department of much greater importance and of a more comprehensive scope than is usually the case on American roads. He has been closely associated with the management in all important negotiations, and has assisted in more ways than one in bringing about the improvements that have been made in the property. Mr. Wallace has had charge not only of all new construction work, but also of the physical condition of the entire property, comprising the maintenance of way and structures. Mr. Wallace has occupied a variety of positions in railroad work, starting out in life in 1869 as chainman on a survey. After completing a course in Monmouth College, he in a very short time advanced to the head of his profession. In 1879 he was Chief Engineer of a railroad line from Peoria to Keithsburg, Ill., which he located, constructed, equipped and put in operation. This line was later consolidated with the Central Iowa Railroad. From 1883 to 1886 he had charge of transportation as well as engineering on the latter road between Oskaloosa, Ia., and Peoria.

He has also had a varied experience in the construction of bridges, and during 1887, 1888 and part of 1889 was Resident Engineer in charge of the construction of the Sibley bridge over the Missouri River. From 1889 to 1891 he was Resident Engineer in charge of the construction of a four-track independent joint entrance into the city of Chicago for the Illinois Central and the Atchison, Topeka & Santa Fe railroads. This work cost several million dollars, and besides the ordinary construction, embraced prolonged negotiations with the city of Chicago and other railroad companies and corporations, as well as important bridge construction, interlocking and signal plants, and incidental street improvements. Jan. 1, 1891, Mr. Wallace became connected with the Illinois Central Railroad as Engineer of Construction, during which time he planned and executed the elevation of that company's terminal tracks in the city of Chicago, as well as the other improved transportation facilities for the World's Columbian Exposition business. Besides the great amount of construction work which he has carried out for the Illinois Central Railroad Company, averaging approximately $2,000,000 per annum, Mr. Wallace has also had charge of the Maintenance of Way Department, in which the average expenditure was over $3,000,000 per annum. He is not only well known throughout the country as a railroad man and engineer, but in Chicago he is recognized as one of the most public-spirited and progressive citizens. He is a member of the Union League, Hamilton, Kenwood and Technical clubs of Chicago; was last year President of the Western Society of Engineers, and is this year Vice-President of the American Society of Civil Engineers. It is probable that Mr. David Sloan, Assistant Chief Engineer, will succeed him as Chief Engineer of the Illinois Central.

The Bettendorf I-Beam Bolster.

In the July issue of this journal, page 231, in describing the Bettendorf I-Beam Bolsters, we stated, in speaking of the tests of the body bolsters, that under a load of 130,000 pounds the permanent set was 1.01 inches. We are now informed that the report given us was incorrect, and that the deflection was 1.01 inches, while the permanent set was only 0.79 inch. We are glad to correct this error because the tests were much more favorable to the bolsters than the first statement would indicate.

American Institute Fair.

The recent improvements in applications of methods of traction are to be a feature of the American Institute Fair which is to open September 20 and continue until November 4 at Madison Square Garden, New York City. The Officers of the Board of Managers of the 1897 Fair are Dr. P. H. Murphy, Chairman; Oliver Barratt, Vice-Chairman; Alfred Chasseaud, General Superintendent; George Whitefield, Jr., Secretary, and Allen S. Williams, Chief of the Press Bureau. Everything pertaining to railways or any phase of transportation by land or water is included in the Department of Intercommunication, which comprehends the greatest of all fields

for the genius of the American inventor whose study and experiments have already almost resulted in the annihilation of space and time. The committee in charge of this department—in many respects the most important of all with the American Institute—consists of Mr. Charles Gulden and Mr. S. McCormick.

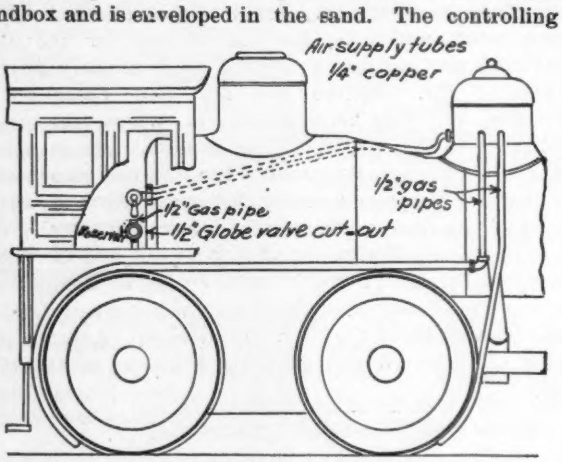
Properly comprehended in the Department of Intercommunication are locomotive engines, cars or models of anything or a part of anything pertaining to the operation or construction of railways. Everything pertaining to road vehicles, which includes motor carriages, models of vessels for navigating the ocean, rivers, lakes and canals of their component parts and of locks, docks, aqueducts or any life-saving apparatus, electric telegraphs, telephones, signals and alarms, implements and contrivances for distributing mails, apparatus for extinguishing fire, and fire escapes, all gas apparatus, implements for expediting trade, locks, safes and hoisting apparatus, articles used especially in hotels and restaurants, devices, apparatns and materials used in the army, navy and the mint and in public edifices and works.

The American Institute has a system of awards for meritorious inventions and improvements which for fairness and value is unsurpassed.

The Houston Track-Sander.

Automatic sanders have become a feature of locomotive equipment, and they are specially necessary in this country, where trains are heavy and stops are frequent. The use of sand is specially necessary with the increased demands of passenger service, and a reliable device for distributing it uniformly is as important in stopping as in starting trains. To effect this result the apparatus must be simple and free from features which may easily get out of order. The accompanying engravings illustrate the plan which is followed in the construction and application of Houston's pneumatic track-sander, which is controlled by the Western Railway Equipment Company, of St. Louis, Mo., of which Mr. E. S. Marshall is Manager.

The essentials of the system consist of a sand siphon and ejector in the sand box, a controlling valve in the cab and the necessary piping. The siphon rests about 1½ inches above the bottom of the sandbox and is enveloped in the sand. The controlling de-

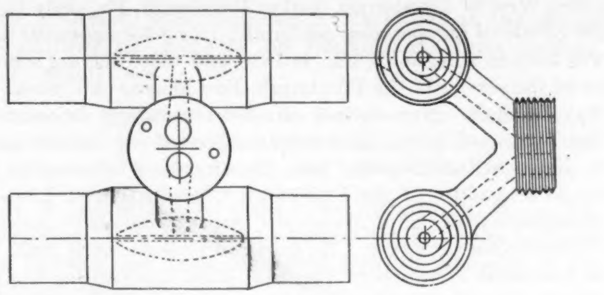


Houston's Track Sander—Piping.

vices are an ordinary ½ inch globe valve and an engineer's valve. The globe valve is used as a cut-out and the other valve graduates the supply of sand upon the rails. This valve has four positions and by it sand may be delivered to the forward tubes only, to the rear tubes only, or to both the forward and rear tubes simultaneously. The last mentioned position of the valve is of service in making emergency stops. Two ¼-inch copper pipes lead from the engineer's valve to the siphons, and from the siphons the sand is carried to the rails through four ½-inch pipes, one pair leading in front of the forward wheels, for use in running ahead, and the other pair leading behind the rear drivers, to be used in backing. Sand flows to the siphon by gravity and it is blown under the wheels by the pressure of the air, the velocity as it emerges from the pipes serving to carry it to the points of contact between the wheels and the rails, even when the locomotive is running rapidly. The piping is simple and easily applied. The control of the sand is reported to be satisfactory, and a list of 33 roads now using the system speaks well for its reception.

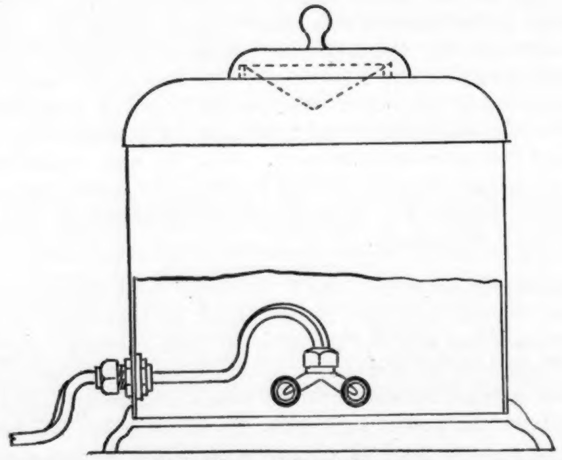
Nickel Steel.

A paper upon "Nickel Steel as an improved material for boiler shell plates, forgings and other purposes," was read by Mr. W. Beardmore before the Institution of Naval Architects at its recent meeting. He said in the history of iron and steel there had been many alloys which, when first introduced, gave promise of great usefulness, but which on experience ended in disappointment. Quite the reverse had, however, been the case with nickel steel, which had now proved worthy of the confidence placed in it by its supporters. For 12 months he had been continuously engaged in the manufacture of nickel steel for a large variety of purposes, and the results had been eminently satisfactory. He contended that the alloy had many advantages over ordinary mild steel. The *sine*



Sand Siphon.

qua non of a structural material was that it should be reliable. They required a metal which could be worked without any special care on the part of the artisan, which was strong and reliable, and would give the same results any time and anywhere. He claimed that nickel steel fulfilled all these conditions, and was the most suitable material to meet the demand for a metal stronger than steel. He suggested that the qualities of nickel were due to the nearness with which the atomic volume approximates to that of iron. In nickel steel they had a metal whose elastic limit was equal to the ultimate strength of ordinary carbon steel, and yet had none of the treacherous brittleness so painfully evident in the latter. It could be punched and bent quite as successfully as ordinary carbon steel, and he had found no difficulty in welding it. It was also worthy of note that the casemates of the Japanese war



Side View of Sand Box.

ship *Fuji* were made of nickel steel, without face hardening by "carburizing," and he was now making nickel steel casemates for the two ships now being constructed on the Tyne. To prove the usefulness of nickel steel when exposed to the action of sea water, he gave details of some experiments at Leith Docks, which proved that the loss in corrosion was less in nickel steel than in either mild steel or wrought iron. The bearing of these experiments on the use of nickel steel for propellers would be evident to any marine engineer. In his opinion, if propellor shafts were made of nickel steel, the question of failure would seldom arise, because a crack in nickel steel would not develop as it would in ordinary carbon steel. In fractures the appearances were different; in the case of carbon steel it was crystalline, but in the nickel it was fibrous. The subject, he concluded, was a most fascinating one. There were

many points on which he would like to have touched—its electrical magnetic properties, for example; but enough had been said to show that nickel steel fulfilled, in a most satisfactory manner, the conditions required of a material for shipbuilding and engineering purposes in an age not characterized by the modesty of its demands.

Convention of the Traveling Engineers.

The Traveling Engineers' Association will hold its annual meeting in Chicago, Sept. 14 next at the Chicago Beach Hotel, where members and their friends will be entertained at the rate of $2.50 per day. The following constitute the committee of arrangements: R. D. Davis, Illinois Central Railroad, Chairman; W. O. Thompson, Lake Shore & Michigan Southern Railway; F. D. Fenn, Crane Manufacturing Company; J. S. Seely, Galena Oil Company; Jas. Fitzmorris, Master Mechanic Union Transit Company, and S. W. McMunn, Old Colony Building, Chicago.

Electricity Versus Shafting in the Machine Shop.*

BY C. H. BENJAMIN.

The ordinary machine shop of to-day, in its shape and size and in the general arrangement of its engines and machinery, is the slave of shafting transmission. The engine must be so located as to connect conveniently with the shafting; all the machines must be arranged in parallel lines, for the same reason; while the ceilings and posts must be designed with special reference to the demands of hangers and brackets. This has been so long the case that perhaps we hardly realize the possibility of a change.

Machinery should be arranged with reference to the work it is to do, and not with reference to the power to be used; it should be so located on the floor of the shop as to be easily accessible for operation and attendance, and in such a way that the work may be readily handled and well lighted.

The whole shop should be planned with a view to handling the product with the least waste of time and labor, and electricity makes this possible. Large machines may be put in any position and at any angle, or, if need be, may be transported from place to place to accommodate the work. The power plant may be located in the most favorable place for taking care of coal, water and ashes, and the power distributed to any building or buildings with but little loss.

In all shops doing heavy work, the rapid and economical handling of the work is one of the most important factors in cheap production.

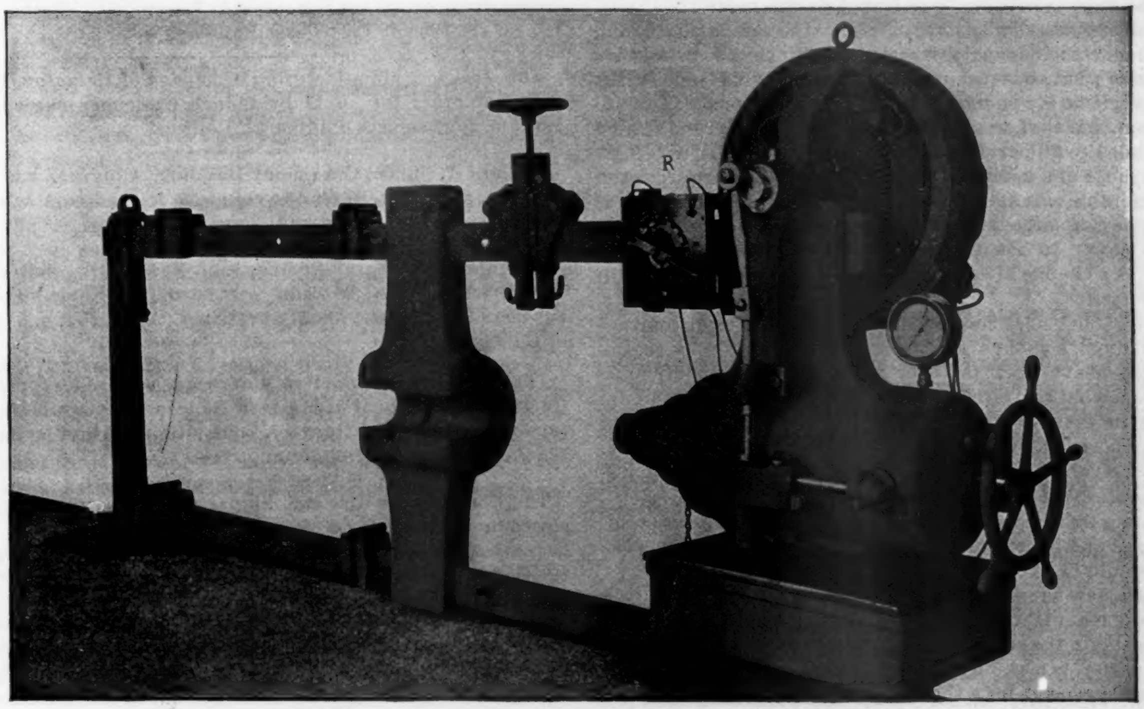
The electric crane is the most convenient and efficient carrier yet developed, and the absence of overhead shafting and belts in electric transmission makes its use possible over all the larger machines.

This advantage of the electric system was what prompted its introduction into the Baldwin Locomotive Works, and the saving there has been notable. Formerly from 30 to 40 laborers were employed to handle the work in the wheel-shop, while now only 8 or 10 are needed; formerly from 8 to 10 per cent. of the time of the skilled help was lost from delays in handling, but this loss has been reduced to less than two per cent. A saving of this kind is of more importance than any probable saving of coal.

As another result of our long subjection to ordinary methods of conveying power, we have come to regard a machine shop as necessarily dark, a synonym for all that is black and dingy. A glance at the shops of some of our electrical establishments will convince anyone that this is a mistake.

Shops like those of the Crocker-Wheeler Company, the Westinghouse Company, etc., have been called "show places"; but at least they *show* the way from darkness into light, and should receive credit for it.

The belt is a dust carrier as well as a power carrier, and nothing can be kept clean in its vicinity. When we add to this the shadows cast by the shafts and belts themselves, we have a condition of things which tends to mistakes and poor work, and cannot be without a corresponding moral effect on the workman.



Electric Motor Applied to a Hydraulic Wheel Press.

The partial or entire absence of overhead belts, and the diffused light reflected from whitewashed ceilings and walls, will cause an improvement in both quantity and quality of output, which will prove a strong argument for electricity.

One of the minor advantages of direct-connected motors on large machines is the possibility of easily and quickly adapting the speed of the machine to the kind of work being done. On large boring mills and lathes, especially when facing up work, this may be a factor of considerable importance in determining the cost of production.

The ease with which the electric system of transmission may be adapted or extended is one of the strongest arguments in its favor The extravagant consumption of power is probably due, in most cases, to a gradual extension of the shafting system by lengthening shafts beyond a reasonable limit, to the turning of corners with bevel gears, and to the use of turned and twisted belts, with their attendant evils in the way of guide pulleys.

Shops are usually planned with a view to present needs rather

*From paper read before the American Society of Mechanical Engineers, Hartford meeting, 1897.

than future possibilities, and extensions are made at some disadvantage; but in the electrical shop this need cause no uneasiness. Whatever the location or the angular position of the new building, the only expense is that of new motors and a few hundred feet of wire.

If the right kind of an electric system be chosen, the same current can be used in a variety of ways which are just beginning to be appreciated. Besides the advantage of having arc and incandescent lamps without any additional expense for generators, the electric current may be used for welding, brazing, soldering, annealing and case-hardening, and each and all of these operations may be effected locally on large machines without moving them from their positions.

Some are inclined to look askance on electric motors, and to have doubts as to their durability and freedom from accident. To the ordinary manufacturer and superintendent the electric motor is something that he does not fully understand, and, consequently, something to be distrusted.

An electric motor, if properly designed and constructed, requires no more care than any piece of machinery running at the same speed. The writer has had under his personal observation motors which have run for years whenever called on, have required less care than an ordinary loose pulley, and have cost almost nothing for repairs.

Only lately the writer saw a railway motor driving a grinder for pulverizing furnace linings, in an atmosphere so full of grit and dust that the operator had to keep his mouth and nose masked. The motor under a street car will convince the most superficial observer that there is nothing to be feared on this score.

It is difficult to get reliable and precise data from actual examples, even from establishments where both kinds of transmission have been tried; but the most universal testimony of such is that the new experiment is a success, that they would not go back to the old system, and that as rapidly as possible the electric system will be extended to all parts of the works.

When the shops of a manufacturing establishment are scattered over a considerable extent of territory, the installation of a central power plant having large and economical engines, and the distribution of the power to the different shops by wires, instead of by steam pipes, is a change always to be recommended, and that will soon pay for itself.

When the establishment consists of one large building or compact group of buildings, a change to the electric system is to be recommended where heavy work is to be handled, especially if the machines are somewhat scattered, require considerable power, or are intermittent in their action. In such cases some of the shafting may be left in position, but the writer believes that the more independent motors are used on machines requiring over two horse-power the greater will be the economy.

In shops doing light work and having many small machines compactly arranged and in continuous operation, a change to the electric system would be expensive and of doubtful utility.

In building a new shop the chances are better for electric installation, and any manufacturer who does not, under these circumstances, investigate the subject and consider carefully the question of using electricity, is making a great mistake.

The ideal arrangement for a shop handling heavy work is that of a building having one lofty center aisle lighted from above, and two side aisles of less dimensions lighted from the sides. Every square foot of floor space in the central aisle should be commanded by electric cranes. Here the larger tools will be located, each with special reference to convenience in handling work, and, as far as practicable, fitted with independent motors.

The smaller machines are located in the side aisles near the dividing line of columns, and may be driven in groups by short lines of shafting hung on the columns below the tracks of the traveling cranes, each line being driven by a separate motor.

Units of about five horse-power are large enough for this kind of work.

Motors of two or possibly of one horse-power are as small as can at present be economically used.

The benches for hand work should be located at the side walls near the windows. Smaller cranes and electric hoists may command all the space in the side aisles.

Some of the drills and shapes should be fitted with direct connected motors and have eye-bolts at the top by which they may be moved from place to place.

In the power-house the use of two generators, one large and one small, will often prove economical, the smaller one being used for night or overtime work.

EQUIPMENT AND MANUFACTURING NOTES.

The Presidential car scheme inaugurated sometime ago by the *Railroad Car Journal* has fallen flat.

The Union Switch and Signal Company has been awarded the contract for interlocking the tracks of the new South Union Station in Boston.

Wm. Sellers & Company have received an order for a number of injectors for the locomotives which are being built at the Baldwin Works for Japan.

The Secretary of the Navy decided on July 16 to close a contract with the Harlan & Hollingsworth Company for a 340-ton torpedo boat to cost $235,000.

The Chicago, Milwaukee & St. Paul Railway is building 250 stock cars at its West Milwaukee shops. The McCord journal box and lid will be used on these cars.

The works of the W. Dewees Wood Company, of McKeesport, Pa., have resumed operations after several weeks of idleness. This refers to mills numbered 6, 7, 8 and 9.

The Rogers Locomotive Company has taken an order for a 12 by 18-inch four-wheel locomotive for the New Jersey & Pennsylvania Concentrating Works of Edison, N. J.

Keasby & Mattison's magnesia lagging will be used on the five locomotives which the Schenectady Locomotive Works are building for the Florida East Coast Railway.

The Dickson Manufacturing Company of Scranton, Pa., has received an order for an 18 by 24-inch passenger engine from the Buffalo, Rochester & Pittsburgh Railroad.

Willard A. Smith, Old Colony Building, Chicago, has taken an order from a Western road to equip 200 freight cars with Bettendorf metal body bolsters and Cloud steel trucks.

The Magnolia Metal Company, of New York, quotes Magnolia Anti-Friction metal 25 cents per pound, No Name metal 18 cents per pound and Mystic metal 8 cents per pound, all f. o. b. New York or Chicago.

The Richmond Locomotive Works has received orders from the Galveston, Houston & Henderson Railroad for two 19-inch switching locomotives; and from the Louisville & Nashville Railroad for ten 21-inch consolidation locomotives.

The National Switch and Signal Co., of Easton, Pa., recently closed a contract for a 20-lever interlocking plant at the East Ottumwa, Ia., crossing of the Chicago, Rock Island & Pacific and the Chicago, Burlington & Quincy Railroads.

Three of the locomotives built by the Pittsburgh Locomotive & Car Works for the Pittsburgh, Bessemer & Lake Erie Railroad have been completed. They weigh about 80 tons each, and are among the largest engines ever turned out at the works.

A stone wall almost a mile in length with an average height of 18 feet, has been built along Second Avenue, in Pittsburgh, by the Baltimore & Ohio Railroad Company. This is a part of the half million dollar improvement that the company is making at that point.

The Ingersoll-Sergeant Drill Company has furnished three duplex cross-compound air compressors to the Atchison, Topeka & Santa Fe. They are fitted with Meyer cut-off valves and with intercoolers and will furnish 600 cubic feet of free air per minute compressed to 100 pounds' pressure.

The Cincinnati, Portsmouth & Virginia has placed an order with the Ohio Falls Car Manufacturing Company, of Jeffersonville, Ind., for 50 flat cars of 60,000 pounds' capacity. These will be equipped with Tower couplers, New York air-brakes, diamond trucks and combination truss brakebeams.

The Richmond Locomotive Works will build two switching engines for the Galveston, Houston & Henderson Railroad, four compounds for the Missouri, Kansas & Texas, ten 21-inch consolidation engines for the Louisville & Nashville Railroad, and 10 locomotives for the Southern Railway.

Pratt & Letchworth, of Buffalo, N. Y., have received an order from the Brooks Locomotive Works to furnish castings for three locomotives for Japan. The company recently made a lot of cast-steel locomotive driving-wheel centers for the same works, which were thoroughly tested, with satisfactory results.

The steel department of the Shickle, Harrison & Howard Iron Company, is reported to be busy, and the capacity of the foundry will soon be increased. One of the furnaces is being completely rebuilt, to add to its capacity, and the construction of a third furnace will be begun as soon as work on the second is finished.

The Pittsburg Testing Laboratory reports a great deal of business on hand, including a number of tests on large steam pumping plants. The necessity for steam users to assure themselves that their plants are economically operated will undoubtedly keep such a well-managed concern busy aside from its other test work.

The Baltimore & Ohio Railroad has just completed on Henderson's Wharf, in Baltimore, a six-story tobacco warehouse which has more floor space than any other building in the city. It cost about $150,000, is equipped with all modern machinery for handling tobacco, and has four electric elevators. The building is fireproof and electric lighted.

The Westinghouse Electric and Manufacturing Company has received from the St. Lawrence Construction Company, of New York, a contract for 15 500 horse-power generators for its plant at Massena, in Northern New York. This is said to be the largest single contract for electrical apparatus ever awarded. The amount involved is about $750,000.

The Union Car Company, of Depew, N. Y., has leased the shops of the Schuylkill Navigation Company, at Reading, Pa., for the purpose of building a plant there for the manufacture of chilled car wheels. Mr. R. E. Coleman, General Superintendent of the Depew Works, will have charge of the new plant, which will have a capacity of 400 wheels per day.

The Brooks Locomotive Works have delivered two passenger engines to the Monon. This concern has also received an order for an 18 by 24-inch passenger engine for the Buffalo, Rochester & Pittsburgh Railroad and one from the Great Northern for 16 moguls with 19 by 26-inch cylinders. The Mexican Central has also given them a contract for 20 locomotives.

The Illinois Central Railroad has placed an order with the Rogers Locomotive Company for five, and with the Brooks Locomotive Works for 10, standard 19-inch by 26-inch mogul locomotives. The Illinois Central has also given an order to the Rogers Locomotive Company for four 10-wheel locomotives, and another order for one eight-wheel passenger locomotive to the Brooks Locomotive Works.

The Schenectady Locomotive Works has an order for 10 additional locomotives of the 10-wheel compound freight type for the Northern Pacific. These will be similar to those ordered last month, making 18 new engines of this type. These engines will relieve about 30 moguls now in service, which in turn will relieve about 50 17 by 24 inch engines, and permit of an entirely new distribution of power.

Statements have been received by the *Manufacturer's Record* from different locomotive works, of the country which show that since January last of this year over 100 locomotives, valued at $1,100,000 have been ordered or purchased by railroad companies in the South. The orders include about 90 from standard gage rail roads, and the bal ance distributed among lumber and mining companies which own private railroad lines in the Southern States.

In connection with the armor plate contracts the Philadelphia *Public Ledger* prints a statement to the effect that the Carnegie Company is considering a proposition for the sale of its plant to the Russian government. This report has been in circulation in ordnance circles for some days, and, while the representatives of the companies in New York profess to know nothing about it, some ordnance experts believe there may be some foundation for it.

The National Switch & Signal Company has orders for three interlocking plants for the Chicago & Northwestern; two for the Chicago, Burlington & Quincy; one for the crossing of an electric railway with the Nickel Plate at Painesville, near Cleveland, and one for Pompton Junction on the Erie. This is all new work except the last-mentioned contract. The material for the interlocking plant at State Line with the exception of the machine has all been shipped. This machine has a 224-lever frame.

The Baldwin Locomotive Works have received an order for two consolidation engines for the Oregon Improvement Company. These will have Richardson valves, Krupp tires, Paige steel tired wheels, Westinghouse brakes, Nathan lubricators, Monitor injectors, Leach sanders and Utica headlights. These builders have also received an order for six 10-wheel locomotives for the Texas & Pacific, and one for a consolidation locomotive for the Oahu Railroad and Land Company of Hawaii.

The new third-rail electric railway system operated by the New York, New Haven & Hartford Railroad Company is to be further extended by equipping another track in addition to the present single-track line between Berlin and New Britain. It is also intended to extend out to Bristol and Plainville, which are already connected by trolley lines with Hartford. In making these extensions the company has been guided by the excellent results, commercial and otherwise, obtained by the lines in operation.

A correspondent writes from Tientsin, China, to the London and China *Telegraph*, London, May 26, 1897, as follows: "The rail contract fell to Mr. C. D. Jameson, an American civil engineer, who has been for some time resident in Tientsin. His figures were far and away the lowest sent in, and he quoted for Carnegie material. The total value of the two consignments is said to be just under $310,950. As this is the first time American steel has triumphed over European in competition by closed tenders it has attracted much remark."

The Detroit Graphite Manufacturing Company, of Detroit, Mich., has recently acquired the title to the graphite mines in Northern Michigan from which they have been making their Superior Graphite Paint. The ore from this mine produces the best pigment for paint so far found. This pigment is reduced to a fineness never before obtained from graphite, and none of the graphitic carbon is taken from it to be used for other purposes. It is unassailable by acids or chemicals of any kind, and is of an absolute uniform quality. The Superior Graphite Paint made by this company has obtained an enviable popularity.

The Grand Trunk Railway Company has leased its car wheel works at Hamilton, Ontario, to a private corporation made up of the St. Thomas Car Wheel Company and the Montreal Car Wheel Company, and these two companies have entered into a contract with the road to make all the wheels required during the term of the lease. The Hamilton works are to be enlarged, and besides all the car wheels required by the Grand Trunk the new concern will seek outside business, such as the manufacture of wheels for other railroads and for electric car companies. The new arrangement is expected to be more economical for the road.

The double track at Seven Curves, on the Baltimore & Ohio, was opened for traffic at 12:50 p. m., July 4. During the past eight months a large force of men has been engaged in making deep cuts through the hills to straighten one of the worst portions of the road, and the company's officers felt very much gratified on Independence Day when the Chief Engineer announced that the work was completed and ready for the trains. Not only will this improvement prevent a great many derailments and reduce the cost of operation, but it will make riding very much more pleasant over that division. The cost of this work was very nearly $100,000.

The Schenectady Locomotive Works is building three 12-whee or "Mastodon" compound locomotives for the Butte, Anaconda & Pacific Railroad. These engines are the largest of this type ever constructed, the cylinders being 23 inches and 34 inches in diameter with 32 inch stroke; driving wheels 56 inches in diameter; weight of engine in working order, about 189,000 pounds. The boilers are of the extended wagon top, radial stayed type, with about 3,000 square feet of heating surface and will be built to carry 200 pounds working pressure. The engines have cast steel driving wheel centers, and both cast and pressed steel are used very largely in their construction.

The E. P. Allis Company, of Milwaukee, Wis., has just received an order from the Central London Underground Railway, of London, England, for six cross-compound engines of 1,300 horse-power each. They are to be coupled direct to electrical generators, and are of the same type as those used in the Baltimore & Ohio Railroad tunnel in Baltimore, Md. Another order has been taken for four similar engines to go to Sydney, New South Wales, for use on

Government tramways. A 1,600 horse-power cross-compound engine has been ordered of this company for the Sagamore Manufacturing Company, Fall River, Mass., to be used for operating the machinery of the entire plant.

The Building & Sanitary Inspection Company has just been organized in New York, primarily for the purpose of inspecting and reporting upon the sanitary conditions of buildings and also to superintend the construction of buildings, and to carry on a civil and mechanical engineering business. Aside from the sanitary work, expert tests and reports will be made upon boilers, engines and electric equipment. The inspection of the sanitary condition of railroad stations will be made a specialty. The officers of the company are: President, George Sherman; Vice-President, Wm. C. L. Gendre; Secretary and Treasurer, Thomas H. Robinson; General Manager, Morton E. Davis, and Chief Engineer, Jas. C. Bayles. The headquarters of the concern is at 53 Liberty street, New York.

H. K. Porter & Company, of Pittsburgh, will build the following pneumatic haulage plants for mine service: The Mount Carbon Company, Limited, Powellton, W. Va., consisting of compressor, pipe lines, charging stations, etc., together with one 8 by 14-inch class "B" pneumatic locomotive; one 10½ by 14-inch class "C" motor for the Carbon Coal Company, Greensburg, Pa.; two 7 by 14-inch class "B" motors for the Mill Creek Coal Company, New Boston, Pa. The storage reservoirs on all these motors are designed to carry 700 pounds' pressure per square inch, with the exception of the one for the Cross Creek Coal Company, which is designed for 650 pounds' pressure. In almost every case these orders were secured in direct competition with electric companies who were figuring on the electric equipment.

A patent has been issued jointly recently to Alfred E. Hunt, of Pittsburgh; Benjamin Talbot, of Pencoyd, Pa., and Percival Roberts of Philadelphia, on the use of carbide of silicon in the manufacture of steel. Carbide of silicon is made by passing an electric current through a cove of sand mixed with coke. The finer and better grade is used as an abrasive, but there is produced considerable material which is not valuable for that purpose and can be sold cheaply. It has been used experimentally at Pencoyd. It is split up and gives both silicon and carbon to the molten steel. It quiets and solidifies the metal and may become useful in the manufacture of castings and other specialties when solid metal is desired. It has the advantage over ferro-silicon, with 10 to 12 per cent. of silicon, because the silicon in the carbide is concentrated, the carbide containing about 70 per cent. of silicon and 30 per cent. of carbon.

The Philadelphia & Reading inaugurated its summer passenger schedule on the Atlantic City line July 2 by placing a fast train in service between Philadelphia and Atlantic City. The train is arranged to leave Philadelphia, Chestnut street and South street ferries at 3:40 p. m. Eight minutes are allowed for ferriage and transfer of passengers to cars, and the time table calls for the start to be made from Camden at 3:48 p. m and to arrive in Atlantic City, a distance of 55.5 miles at 4:40 p. m. The first trip of this train on July 2 was a signal success. On this trip there was a delay in the ferriage of 2½ minutes, and it was 3:50½ when the start was made from Camden. Notwithstanding this the train came to a stop in the Atlantic City depot at 4:38½, 1½ minutes ahead of its regular time the distance being covered in 48 minutes. The trip was made under the most unfavorable conditions, the rail was very slippery several miles being run through a very violent thunderstorm, with very heavy winds making it impossible to see more than a half train length ahead, which caused the engineer to slow up, otherwise the running time would have been still less. The train was composed of one regular combination, weight 57,200 pounds; three standard passenger coaches, weight of each 59,200 pounds; one Pullman vestibule parlor car, weight 85,500 pounds, and was drawn by the standard A. C. R.R. engine No. 1027, which is a Baldwin compound engine known as the Atlantic type. This engine has two pairs of driving wheels, 84¼ inches diameter. The high pressure cylinders are 13 inches, and the low pressure, 22 inches diameter, stroke, 26 inches. The firebox is 113⅝ inches long by 96 inches wide. The boiler has 278 tubes 1¾ inches diameter; the total heating surface of the engine is 1,835 square feet. The total weight of locomotive and tender is 220,000 pounds. The total weight of engine and train 647,200 pounds. We are informed that the journal bearings for the engine, passenger and Pullman cars of this train are of the Ajax metal throughout.

Our Directory

OF OFFICIAL CHANGES IN JULY.

Chicago, Peoria & St. Louis.—Mr. C. H. Bosworth has resigned as vice president and General Manager, and has been succeeded by Mr. Henry W. Gays.

Chicago, Burlington & Northern.—Mr. N. Frey has been given charge of the locomotive and car departments, vice Mr. W. H. Lewis.

Chicago, Iowa & Dakota.—Mr. H. C. Stuart, General Freight and Passenger Agent, has, in addition, been appointed General Manager of that road, to succeed Mr. William S. Porter, resigned.

Columbus, Sandusky & Hocking.—M. F. Bonzano has been appointed General Agent for the Receiver, with headquarters at Columbus, O. He will represent the Receiver in his absence, and will have direct charge of the traffic and operating departments. Mr. William E. Guerin has resigned as President and General Counsel.

Duluth, Missabe & Northern.—Mr. T. J. McBride has resigned as First Vice-President, but will continue as General Manager of the road.

Delaware, Susquehanna & Schuylkill.—Mr. Alfred Walter has resigned as President to accept the Presidency of the Lehigh Valley.

Forth Worth & Rio Grande.—R. H. Lord, Superintendent of Transportation, having resigned to accept other employment, the office has been abolished and its duties will hereafter be performed by C. H. Stevens, Chief Dispatcher, with office at Fort Worth, Tex. B. G. Plumber has been appointed Master Mechanic, with office at Fort Worth, to succeed H. D. Galbraith, resigned.

Huntington & Broad Top Mountain.—Mr. George F. Gage, General Manager, has resigned.

International & Great Northern.—The title of F. Hufsmith, whose headquarters are at Palestine, Tex., has been changed from Master Mechanic to Superintendent of Motive Power and Rolling Stock.

Kewaunee, Green Bay & Western.—Mr. S. W. Chapman has resigned as General Manager.

Kansas City, Pittsburgh & Gulf.—Mr. Robert Gillham, formerly Acting General Manager and Chief Engineer, has been made General Manager and Chief Engineer.

Lehigh Valley.—Mr. E. P. Wilbur has resigned as President and has been succeeded by Mr. Alfred Walter, formerly President of the Delaware, Susquehanna & Schuylkill.

Norfolk & Western.—Mr. H. A. Gillis has resigned the position of Master Mechanic.

Norfolk, Albemarle & Atlantic.—Mr. James W. Andrews has been appointed Master Mechanic, with headquarters at Brambleton, Va.

Oconee & Western.—Mr. A. J. Mentor has been appointed Master Mechanic at Dublin, Ga.

Santa Fe Pacific.—Mr. W. G. Nevin, General Manager of the Southern California, has also been appointed General Manager of the Santa Fe Pacific.

St. Louis, Chicago & St. Paul.—Mr. Henry W. Gays has been appointed General Manager of the Chicago, Peoria & St. Louis, with headquarters at Springfield, Ill., to succeed Mr. C. H. Bosworth. Mr. Gays retires from the general management of the St. Louis, Chicago & St. Paul.

MASTER CAR BUILDERS' ASSOCIATION.

ABSTRACTS AND SUMMARIES OF REPORTS PRESENTED AT THE THIRTY-FIRST ANNUAL CONVENTION.

(Concluded.)

Improved Freight Car Buffers.

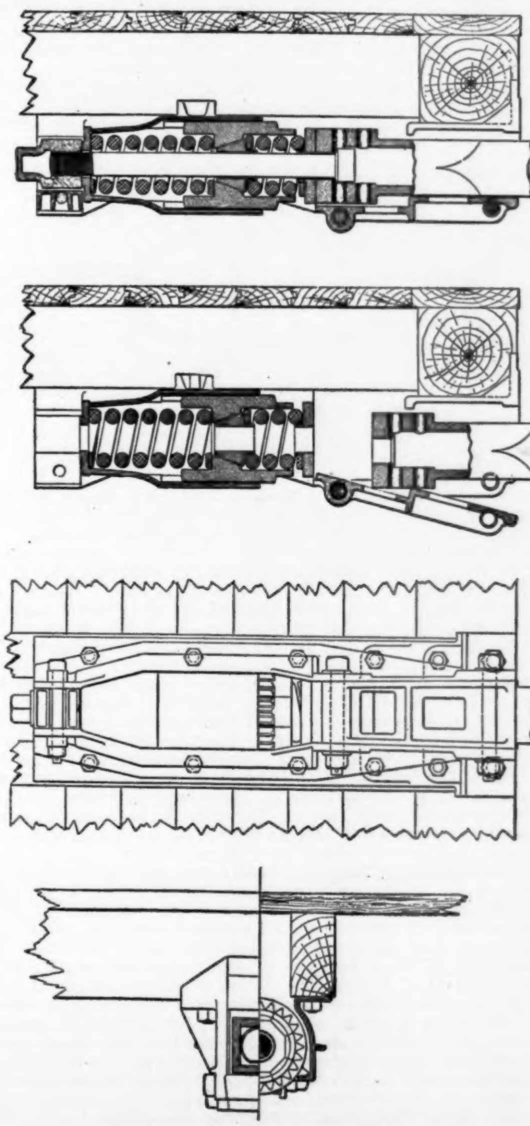
WM. FORSYTH, A. E. MITCHELL, F. W. BRAZIER, THOS. FILDES, JOHN PLAYER, Committee.

Your committee, appointed to follow up and report upon experiments made with improved buffers, has had its attention called to only two improved freight buffers, namely, the Gould spring buffer and the Westinghouse friction buffer.

The Gould buffer consists of two malleable iron cases, each containing helical springs, having a capacity of 12,000 pounds each. The total capacity of the buffer is therefore 24,000 pounds. A number of these buffers have been placed in service on the Lake Shore Railroad, and a few for trial on the Erie and the C., B. & Q. The tests have been simply those for endurance in ordinary service, and the results in that respect have been satisfactory. The cost of cast-iron buffers, M. C. B. pattern, is about $3.60 per car; malleable iron, $4.40. The Gould spring buffers cost $15 per car. The capacity of the Gould buffer, 24,000 pounds, is only sufficient to absorb the work done by a loaded 60,000-pound car, total weight 90,000 pounds, running at a speed of 1.08 miles per hour.

The improved Westinghouse friction draft gear is shown in the accompanying engraving. It has been in service on 50 coke cars for eight or nine months, and has required slight repairs to but few of the cars. The committee witnessed a test of the draft gear on these cars, after eight months' service, on the southwest branch of Penn-

sylvania Railroad. The loaded cars, having a total weight of 58,600 pounds, were thrown together at speeds approximately four to six miles per hour. Under such conditions the motion of compression was 2 to 2$\frac{5}{8}$ inches, and the capacity of the draft gear just about absorbed. A shop test of one of these gears was then made under a drop weighing 16,000 pounds, and it was found that a fall of 9 inches just closed it through a motion of 2 inches. In order to get an approximate idea of the pressure required to producean equal amount of work, a copper disk 2$\frac{1}{2}$ inches diameter and 2$\frac{1}{2}$ inches high was placed under the same drop and the weight allowed to fall 9 inches. The compression of the copper disk was $\frac{7}{32}$ inch. A similar disk was then placed in a compression testing machine and it required 152,680 pounds to reduce the height $\frac{7}{32}$ inch. This can, therefore, be taken as the total capacity of the Westinghouse draft gear. As the spring resistance is 15,000 pounds, the value of the frictional part of the device is 152,680 — 15,000 = 137,680 pounds. It will be seen that more than nine-tenths of the resistance is by friction. As this is the controlling resistance, and as it acts in both ways, that is, in recoil in either direction as well as in compression, it will be evident that it exercises a braking action upon, and effectually checks the recoil of the springs. This recoil of spring action frequently causestrains to break in two and racks the draft rigging and car framing. To eliminate these destructive forces is the main object of the Westinghouse draft gear. The work done in compressing it, as shown by the drop test, is 16,000

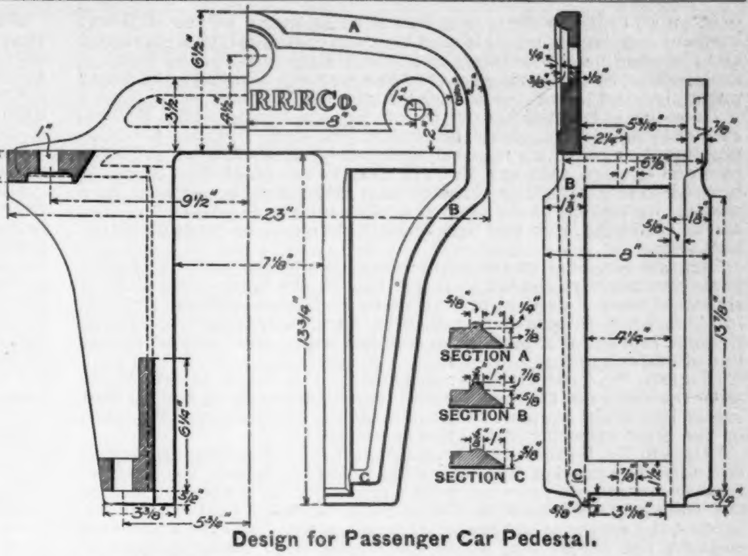


Westinghouse Friction Draft Gear.

pounds × $\frac{3}{4}$ foot = 12,000 foot-pounds. The resistance of the standard draft spring is $\frac{19,000}{2} \times \frac{1}{6}$ foot = 1,583 foot pounds.

$\frac{12,000}{1,583} = 7.5$, which is the ratio of the resistance of the Westinghouse draft gear to that of the standard draft spring.

This former will, therefore, absorb 7.5 times the shock absorbed by the ordinary draft spring. This draft gear is now being fitted to the 600 steel cars, 100,000 pounds capacity, building for the P. B. & L. E. R. R.



Design for Passenger Car Pedestal.

In the above report we have simply followed our instructions, and have given the results of the experiments made. We have no recommendations to make, and now ask to be discharged.

Passenger Car Pedestal and Journal Box for 4 1-4 by 8-inch Journals.

GEO. W. WEST, T. B. PURVES, JR., E. A. BENSON, T. W. CHAFFEE and J. W. MARDEN, committee.

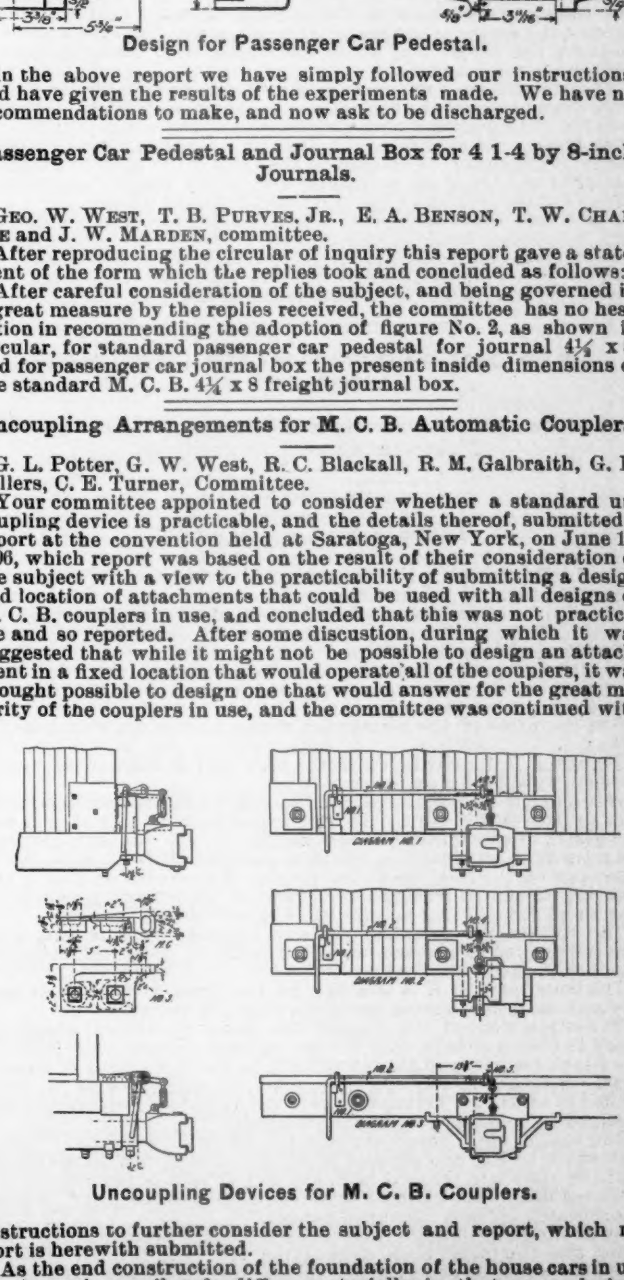
After reproducing the circular of inquiry this report gave a statement of the form which the replies took and concluded as follows:

After careful consideration of the subject, and being governed in a great measure by the replies received, the committee has no hesitation in recommending the adoption of figure No. 2, as shown in circular, for standard passenger car pedestal for journal 4$\frac{1}{4}$ x 8, and for passenger car journal box the present inside dimensions of the standard M. C. B. 4$\frac{1}{4}$ x 8 freight journal box.

Uncoupling Arrangements for M. C. B. Automatic Couplers.

G. L. Potter, G. W. West, R. C. Blackall, R. M. Galbraith, G. B. Sollers, C. E. Turner, Committee.

Your committee appointed to consider whether a standard uncoupling device is practicable, and the details thereof, submitted a report at the convention held at Saratoga, New York, on June 17, 1896, which report was based on the result of their consideration of the subject with a view to the practicability of submitting a design and location of attachments that could be used with all designs of M. C. B. couplers in use, and concluded that this was not practicable and so reported. After some discussion, during which it was suggested that while it might not be possible to design an attachment in a fixed location that would operate all of the couplers, it was thought possible to design one that would answer for the great majority of the couplers in use, and the committee was continued with



Uncoupling Devices for M. C. B. Couplers.

instructions to further consider the subject and report, which report is herewith submitted.

As the end construction of the foundation of the house cars in use on the various railroads differs materially, in that some designs have the end sills concealed under the siding on the end of the car and use a buffer block outside, which varies in thickness and depth on the cars of different roads, while in other designs the end sill projects beyond the end of the car, performing the additional function of buffer, your committee sent out a letter of inquiry to obtain information as to the variety of practice in the designs of the parts affecting the subject under consideration.

Your committee understands that it is desired that it shall submit designs of as many parts as possible that in their opinion can be

used on all ordinary designs of cars with as many of the different kinds of couplers as possible, and that the parts shall be so designed as to be of sufficient strength to insure the coupler, in the event of its breaking or the giving away of the rear end attachments, being uncoupled and prevented from falling on the track.

There are submitted herewith [not all are reproduced. Editor.] cuts showing a lever, clevis, clevis pin, link and brackets for supporting the rod, which it is believed can be applied to all ordinary cars and be used with any M. C. B. coupler in which the block is located in the top plane of the coupler head and is operated by a vertical movement of the lever arm, to which it is attached. The clevis, clevis pin, link and brackets are shown to be made of malleable iron.

Diagram No. 1 shows the application of the proposed standard parts to a car with concealed end sills with the parts of the dimensions and located as shown on "Plate B, Recommended Practice for Attaching Automatic Couplers to Cars," arranged to operate the lock in a coupler having the lock located on the vertical center line of the coupler.

Diagram No. 2 shows the application to the same design of car with the center of the lock located three inches from the vertical center line of the coupler. Within these limits are located the locks on the great majority of couplers in service.

Diagram No. 3 shows the application to a car having projecting end sills. The bracket supporting the end of the release rod farthest from the coupler is provided with a projection to enable the lock of the coupler to be held in the raised position by pushing the rod toward the center of the car, after being raised, until the outer arm engages the projection, a feature which with many designs of couplers is necessary.

The dimensions of the parts as shown will be suitable for all cars with dead blocks of the dimensions as shown on "Plate B, Recommended Practice," and with end sills 8 or 9 inches in depth; for cars with these parts of different depth the proper adjustment can be made by changing the relation of the arms of the lever to bring the center of the eye of the horizontal arm to the proper height above the eye of the lock or by use of links of different lengths.

There are some designs of M. C. B. couplers in use in which the lock is operated from the side or front beneath. As each type has a distinctive method of operating the lock, your committee did not think it necessary to consider them in this report, although some such types are used in considerable quantities.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.

Abstracts and Summaries of Reports Presented at the Thirtieth Annual Convention.

(*Concluded.*)

Truck Swing Hangers.

G. L. POTTER, M. N. FORNEY, W. GARSTANG, W. LAVERY, JOHN MACKENZIE, Committee.

Mr. William Garstang, Superintendent of Motive Power of the C., C., C. & St. L. Ry., made quite elaborate tests with a view to throwing light on this subject. A dynamometer was constructed and attached to the truck axle of a mogul engine, the wheel base and distribution of the weights of which are shown in Fig. 1, and was applied as shown in Fig. 2.

The operation of the mechanism shown on this drawing is as follows:

Flange *A* is loosely fitted to the axle and is kept in its proper position by a feather on the axle.

B is a flange clamped solidly to the axle with a groove cut in the face to receive the ring *C*. To the upper half of this ring is cast flanges *D*, to which is bolted the vernier *E*. To prevent this ring from turning, an arm, *F*, is bolted to each side of the box, on which lugs, cast on the ring, rest. The pointer *G* is pivoted on *E* at *H* and receives its motion from the movement of truck frame through the box *I* and rod *J*. This pointer has a ratio of 4 to 1.

The springs are arranged radially around the axle and were carefully tested on a machine, and a table of pressures compiled for each $\frac{1}{16}$-inch compression.

The boiler vernier *K* is attached to the front of the boiler, and the pointer *L* to the cross-bar of the truck, as shown.

The adjustment of the hanger was done by having blocks *M* fitted to the cross-bars, four for the 6⅝-inch hanger and four for the 8-inch hanger, and slotted radially to suit the length of hanger used. Attached to this block is a plate, *N*, with a series of holes drilled in same, so arranged that the angle of the hanger was changed two degrees by each adjustment.

The hanger pin *O* passes through the clamp *P*, the clamp *P* being slotted for bolt *Q*, and pivoted at *R*. To change the hanger from position shown to the next hole, the bolt *Q* is removed and the pin *O* moved until bolt *Q* can be inserted in the hole required, this being repeated for each change of hanger.

After running through the series of holes mentioned, it was found that the inside holes were giving the best results. Then it was determined to carry the test further until a change was shown, giving an increase of stress. As the construction of the truck was such as to prevent the carrying of the top pin any closer toward the center, the radial arms *S* were made and bolted to the center casting and tests continued until the result desired was obtained, as shown in the tabulated statement.

The tests were made on the Indianapolis Union Railway Company's tracks, where they enter the Big Four tracks at Brightwood, on a three-degree curve with the outer rail raised four inches, which is suitable for a speed of 45 miles per hour. The runs were divided into a series of speeds as follows:

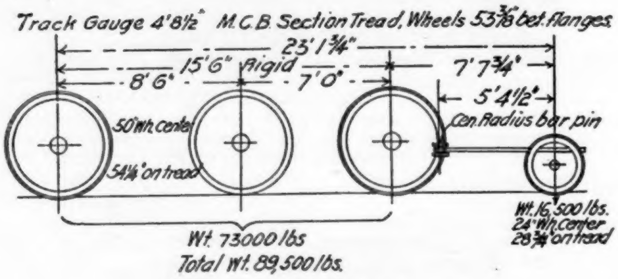
For each angle of hanger and also for a rigid truck; that is, two runs at 18 miles per hour, two runs at 35 miles and two runs at 45 miles per hour, or as near as possible to the above schedule. An average was taken of the runs made with each angle of hanger.

The movement of the pointer *G* was recorded on a card by being connected to a Crosby indicator, *T*, as shown on blue print, and the speed by a Boyer speed recorder, *U*. To insure that all readings were taken at one point, a post was located at the center of the curve, so that it could be readily seen by the operator.

The action of the dynamometer proved contrary to that expected as to its maintaining a constant and uniform pressure after the engine was fully under the influence of the curve. Its apparent action proves that the impact upon entering the curve gave a vibrating action to the springs and, in consequence, to the front end of engine, after which the springs seemed at all times to have been compressed and relieved alternately, which, it is believed, was due to the curve not being a true arc of the circle. The springs, apparently, in addition to this, were compressed to a certain point, and when their combined strength overcame the weight and friction of the wheels on the rails, relieved themselves suddenly and nearly regained their normal set. This gave a line on the card fluctuating from zero to a maximum point, or a resultant stress.

As the vernier is attached to the boiler and the needle to the truck frame, both having a movement in the same direction, the total boiler movement includes the sum of the set shown on the dynamometer and the movement of the boiler vernier past the needle. During these tests, and at random apparently, the results show a peculiar circumstance, namely: Indicators will start and show an increase or decrease in relation to angle of hangers, when the engine will assume a position giving readings nearly fifty per cent. less than would be looked for, this occurring throughout the test, and is, it is thought, due to certain conditions wherein engine assumed a position on track contrary to its general position, or, in other words, hugging the outer rail evenly and smoothly for full length of engine, thereby giving a small truck stress.

The action of the cradle or swing center seemed to be as follows: Hangers which have an angle inside of an inch either way from the vertical, by reason of the small angle, seemed to allow the



Truck Swing Hangers.

boiler to sway to its maximum position and back again to extreme in other direction, this surging tending to raise the stress on truck wheel flange, and speaks for itself in the tabulated results.

Hangers whose angle exceeds this in either direction absorb a part of this sway, and consequently show a reduction of truck stress. The hangers giving the best results, namely, showing the least boiler swing and least stress on the truck-wheel flange, were the hangers whose points of suspension are closer together than the suspending points on the center casting. The length of hangers bears an important relation to stress indicated. For instance, the two lengths of hangers used in these tests, one of which was 8 inches and the other 6⅝ inches long, at the 18-degree angle, suspended as before mentioned, showed results which would indicate that the hanger whose arc is of the shortest radius in a given length of movement, and necessarily has the dreatest middle ordinate, tends to raise the engine more abruptly and suddenly, thereby absorbing a greater percentage of stress and reducing the flange stress in a corresponding ratio. This shows to be in favor of the short hanger, but just what length would be the mean was not determined.

To note the position of engine on the curve at the various positions of the boiler, as shown by tabulated statement, a section of the curve was drawn at 3-inch scale and a tracing made of plan of engine and plan of the truck, which showed that the back driver and truck flange bore against the outer rail, while the front flange cleared with the 6⅝-inch hanger at the 18-degree angle, with a boiler movement of ⅝ of an inch. With a boiler movement of ¾ of an inch and over, the front driver flange came in contact with the rail, and with the maximum movement of the boiler as recorded, the back driving wheel flange bore hard against the inside rail of the curve, and the front driving wheel flange and truck flange bore hard against the outside rail, thereby confirming the record of the road tests and our conclusions that the angle of the hanger giving the minimum flange stress with the minimum boiler movement to be the proper angle to use.

The angles giving the best results for the two hangers in this test were 18 degrees for the 6⅝-inch hanger, and 28 degrees for the 8-inch hanger, which leads the committee to believe that the angle of the hanger should be changed for each length of hanger used.

The Apprentice Boy.

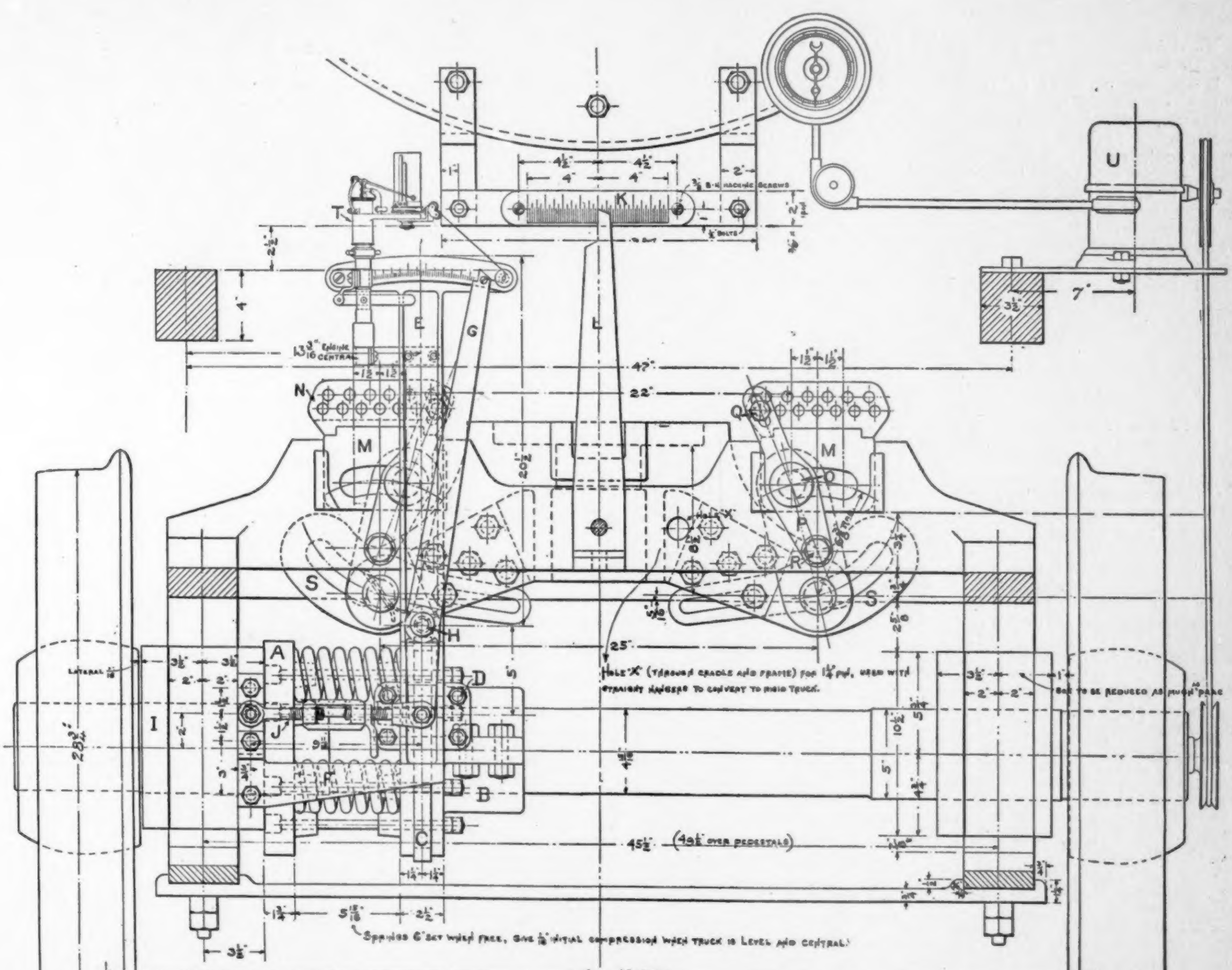
W. F. BRADLEY, W. H. HARRISON, G. R. JOUGHINS, A. E. MANCHESTER, H. P. ROBINSON, Committee.

A year ago your committee submitted a report on the apprentice boy, which will be found published on pages 282 to 290 of the Re-

port of the Proceedings of the Association for 1896, in which your committee dwelt especially on the necessity of educating apprentices outside of the shops. Your committee in that report submitted the substance of correspondence with representatives of the University of Chicago and of Purdue University of La Fayette, Ind. Your committee in that report did not attempt to submit any definite course of training for apprentices in the shops. In the course of the discussion which followed, the committee was continued, with especial instructions to recommend a course of shop training for apprentices in the various locomotive shops.

It confining itself, therefore, to this one specific department of the training of the apprentice, namely, the training inside the shops, your committee does not wish to be understood as considering that this is the only department in which care and pains are needed in the educating of apprentices. It hesitates even to say that the shop training is the most important part of their training. Apprentices must be made not only good mechanics but good citizens and good men. It is easy to say that a railway company is not responsible either for the citizenship or morality of its apprentices, but it is none the less impossible for the company to escape some share of such responsibility—at least of the moral kind. Moreover, on purely selfish grounds, it is to the interest of the railway company to see that the generation which is growing up is not only a generation of competent workmen, but is also a generation of good citizens and good men. In confining itself to this report to the one subject of shop training, your committee is obeying instructions, and for the larger field of outside training it begs again to refer to its report of last year, and to say distinctly that the report submitted herewith is only supplementary thereto, and that the field of shop training is only one department of the much greater field of the general education of the apprentice.

The first question to be considered is the length of term of service which an apprentice should serve. On this subject there are two diametrically opposed views held respectively by those who would place a rigid term of service consisting of a certain number of years or months on the one hand, and on the other hand by those who believe that the length of a term should be governed entirely by the merit and ability of the individual apprentice. From reports received from a large majority of the bigger shops in this country, it is evident that the more general custom is the prescribing of a definite length of service. On the other hand, what the committee will call the merit system is in force in some shops whose practice we all recognize ought to command our highest respect; also the practice in other countries is in favor of the merit system as opposed to a rigid term of service, and in the discussion in the Western Railway Club at the May meeting already referred to the majority of opinion was distinctly in favor of the merit system. If a rigid term of service is fixed, the very great preponderance of practice in this country is in favor of a four-year term. There are one or two cases when a three-years' term is considered sufficient. The committee knows of one case where the term is fixed at five years. The four-year term, however, is almost universal. The committee believes that this term has been fixed as the result of long experience, and is in accordance with good judgment. In four years a boy ought to be able to acquire a thorough training, if he is a boy capable of ever becoming a mechanic. At the same time, four years is not too long a time to make the average boy spend on his training.



Truck Swing Hangers.

In drawing up any shop course, therefore, it should be based on an assumption that it is to cover a period of four years. Your committee, however, does not believe that it is fair to make all boys spend precisely the same time on the same work. Any course must be more or less elastic. Boys differ largely in capacity and in ambition. Moreover, the same boy will show greater aptitude for one part of his course than he will for another. While, therefore, we believe that four years should be regarded as the proper average time of service, and a course should be based on that length of time, there must be left discretion in whoever has charge of the apprentices either to permit a boy to go forward more quickly, or to hold one who is slow longer than the average at a particular class of work. Your committee, however, would not by any means have this to be interpreted as meaning that the discretion of the individual in charge is to be unlimited. With the brightest and most ambitious boy the committee would under no circumstances recommend the shortening of the term below three years. The committee does not believe that any boy ought to spend more than five years. A boy who requires five years of service to go through his course

will certainly at an early stage of his training show such assurance of incapacity as to make it evident that he will never make a good mechanic. In such cases the boy should be promptly sent elsewhere. This power to discharge not only in case of misbehavior, but for the reason stated, namely, of a general incapacity in the boy, must be reserved by the railway company, and ought to be unsparingly and conscientiously used both in the interests of the shop and of the boy himself.

With this understanding the committee submits herewith a schedule for machinist apprentices, which is in use on the Norfolk & Westerd Railroad, and which has been found very satisfactory. [This schedule comprises the work on the machine tools similar to several which are employed on railroads of this country. The report presents schedules for boiler shop and blacksmith shop courses, and in an appendix an academic course and also a form of indenture are suggested. These are too long to be reproduced.—EDITOR.]

Locomotive Grates.

H. WADE HIBBARD, GEORGE W. WEST, DAVID BROWN and EDWARD L. COSTER, committee.

It appears in brief to your committee that a grate should be composed wholly of cast-iron shakers for fireboxes not over the drivers.

For wide fireboxes, those extending out over the drivers, using lump coal, transverse shakers alone, or longitudinal shakers lightened with water tubes between, are recommended.

For wide fireboxes over the drivers using small coal, shakers appear to be preferable in whole or in part.

The earlier locomotives in which attempts were made to use anthracite were rather deficient in grate area. The burning of this refractory fuel was not well understood and these small grates compelled the use of a high grade of coal in order to produce sufficient steam. This is stated by the Reading to have caused the burning out of the cast-iron grate bars then used because of the lack of ashes to settle upon them and protect them. The use of anthracite was consequently not really successful until water grate bars were designed. These were put in by James Milholland from the Philadelphia & Reading Railway. It is further stated by this road that no further trouble was had with melting of grates; and with proper design to give pitch enough to secure circulation, and reasonable care as to removable of washout plugs at ends of tubes and washing out the tubes when boilers are cleaned, it is stated that tubes are entirely satisfactory.

Closing up of tubes by accumulation of mud, with the resulting overheating and burning, appears to be common, even where the greatest precautions are taken in washing out.

Tubes rising up out of the fire is a prominent difficulty and is acknowledged by all but one of those even who prefer the tubes to the shakers. The Pennsylvania never has bars rise up unless they have been closed or nearly so with mud and scale.

Standard slope varies on different roads, but in general is about one inch in 12 inches. The Lehigh Valley uses ¾ inch in 12 inches. The Ontario prefers the greater rather than the lesser slopes; but regards the length and width of fireboxes as having a great deal to do with slope, and the depth from fire flues to water tubes more. Sufficient slope is, of course, needed for circulation in preventing the water from being driven out of the tubes.

Corrosion of tubes.—The Pennsylvania states that it has been quite a common occurrence to have tubes leak at the front and back sheets, and sometimes it is quite difficult to keep a tight joint. When a leak is once sprung it is often found difficult to get the joint tight. It is often found that corrosion has taken place around the joint, and to overcome the leak is still further made difficult.

Corrosion of side sheets is caused by an undisturbed lodgment of ashes against the sheet, and is particularly facilitated if there is also a leak.

Pull-out bars are not recommended to enter from water leg. They are usually in the proprotion of one bar to two tubes, though the Delaware & Hudson uses about one to three. This is obtained by placing only two tubes together, but where a bar is placed as above next the sheet the proportion becomes one to three.

Supports for water tubes and bars are formed by cross-braces whose ends are attached to the mud ring. The Erie states that there should be one intermediate support for fireboxes 6 to 7 feet in length; two supports for fireboxes from 7 to 11½ feet long, which may be spaced unequally if necessary to clear drivers. In the longer fireboxes, if the front end of pull-out bar does not entee front water leg, it should be supported there also. At the rear thr thimble in water leg, through which the pull-out bar passes, should be reinforced inside to allow wear of bar; or else there should be a cross-support there attached to mud ring. Long fireboxes must have the mud ring braced across from side to side to prevent spreading, and this furnishes an easy means for intermediate support of tubes and bars. To this cross-brace a cast-iron piece in one to three sections is bolted, its notched upper edges holding the tubes and bars. Wide fireboxes over drivers require a support made light by combining a 2½ by 3-inch square horizontal bar with a 1½-inch truss rod having nuts at both ends.

The Erie's experience with tubes with filling pieces has not been satisfactory, and engines having this form of grates have been fitted with shaking grates. It was used in engines having either the true Wooten or plain fireboxes over the drivers. There were four drop grates, two in front and two behind, in line with the fire doors. Cleaning the fires was difficult and slow, in which the Lehigh Valley and Ontario concur, and the volumes of cold air which entered the firebox when the drop grates were opened proved very injurious to the flues.

Water tubes with transverse shaker fingers and pull-out bars between are entirely successful on the Delaware, Lackawanna & Western, which uses the combination on passenger engines only. A description is given that "these shaking grates occupy half of the front end of the firebox and have cast fingers which work between water tubes. There are pull-out bars for the remaining portions of grate which occupy the space in the back between the tubes that the shakers do in the front part of the firebox. At first shakers were tried between water tubes the whole length of the firebox; but it was found that it was not necessary, since shakers as now used in front are sufficient. They give good results in passenger service on long runs, where it is necessary to stir up the fire in front end of firebox." There is little or no trouble with the fingers warping and burning.

Technical literature appears to be singularly lacking in the history of the details of the use of anthracite in locomotives, but your committee learns that it is only within the past decade or less that the railroads of this country have been making any efforts to use shaking grates. Their most extensive use to-day is to be found on the Erie Railway, their adoption dating from the early part of 1890. Before this time, water tubes with pull-out bars had been used and were a source of continual trouble. The Erie has now very few locomotives thus equipped. Upon these will be applied, whenever renewals are necessary, either the standard 40-inch cast-iron shaking grate, or a somewhat shorter 32-inch standard grate of same width and general design, with ½-inch fingers and ⅝-inch openings for pea coal, and thicker cross-ribs of 4½ inches maximum depth, used for fireboxes over the drivers. The Erie has found no defects in shaking grates.

The advantages of the shaking grate, in addition to an avoidance of the disadvantages of water tubes, are stated by different roads as follows:

Cleaner and thinner fire and softer exhaust; the improvement of the fire during very long runs by stirring from beneath; quickness and small labor in cleaning fires at stops and terminals (Section 28); ability to use cheap coal having a great amount of refuse (Section 29); economical use of coal; less harmful effect on firebox sheets; less first cost; simplicity, as regarded by the Erie; greater safety, since there are no tubes to burst, no sheets to be injured by rolling and caulking, and no unexpected breakdowns; durability with less careful handling; less expense to keep in good condition; advantage in poor water districts, since water has no effect; quickness and cheapness of repair.

The weight of longitudinal shakers, if without intervening tubes, is four or five times as much as the weight of water tubes and pull-out bars. This has led to the introduction of one or two tubes between shakers, solely on grounds of lightness.

That a cleaner and thinner fire, as well as a softer exhaust, can be used with shaking grates is the experience of the Pennsylvania. The great number of small openings instead of longitudinal openings running the entire length of the firebox prevents much of the small coal shaking through. The Ontario also considers that a thinner fire can be carried on shaking grates; while the Lehigh Valley and the Erie in general see no difference, though some of the latter's Master Mechanics have found the Pennsylvania and Ontario experience to be their own. The softer exhaust required would naturally decrease the cylinder back pressure, and thus increase the power of the engine.

Cheap coal can be better used upon shaking grates because the great amount of ash and refuse is easily removed while running. One branch division uses coal of even 27 per cent. ash upon passenger engines with fireboxes between frames and with shakers. Such coal in so small fireboxes does not give free steaming, but it is referred to as showing what can be done with shakers. Anthracite railroads are finding it necessary sometimes to use slaty coal which they have mined but cannot sell, or which must be purchased from heavy coal shippers; also, in common with all roads, they have some inexpert firemen, who need every advantage to make steam even with good coal.

Economical use of coal is reported by the Erie, Lehigh Valley and Pennsylvania, due to less loss by dropping through the grate and less loss when cleaning fire. The opinion of the New York, Ontario & Western Railway had been that there was a considerable saving by the use of shaking grates over water bars under like conditions of coal, service and engine crew; but the series of tests which have been carried on by the committee, made possible by the kindness of the above road, have not demonstrated this saving. There is more difference in crews than in grates.

First cost is stated by the New York, Ontario & Western to be in favor of the shaking grates, the material alone costing about four-sevenths more for water tube grates than for shaking grates.

The durability of shakers is greatly in evidence, though less care is needed to secure it. With proper locks the fireman is automatically careful and very much less care is needed in the roundhouse in the shape of weekly inspections and washing out of tubes.

Shaking by sections is recommended by the Schenectady Locomotive Works: "A surface 40 inches wide by 11 feet long being divided into three parts, giving greater ease in handling and permitting the different portions of the fire to be cleaned separately." The Pennsylvania pursues this plan upon its latest engines The Erie and Ontario state that a section of 20 square feet is the maximum that one man can handle to advantage, 12 to 15 square feet being much more advisable.

The advantages of the longitudinal grate over the transverse are as follows: No side-bearers to give weight and corrosion; no intricate or short lived side-bearer supports; fewer and more simple parts, including lever connection; can be lightened by tubes in narrow fireboxes; standard eastings rather more profitably adapted for all widths of fireboxes by using one or two intervening tubes than by the filling pieces used for the same purpose with transverse shakers; easier to locate cross-support to avoid driver.

The disadvantages are: Cannot shake front and back parts of fire separately; more difficult to renew; long sections warp sidewise worse; longer sections must be stronger and heavier, especially in the bellying rib; requires more locks; standard castings not so easily adapted to all lengths of fireboxes.

AMERICAN ENGINEER CAR BUILDER AND RAILROAD JOURNAL.

SEPTEMBER, 1897.

CONTENTS.

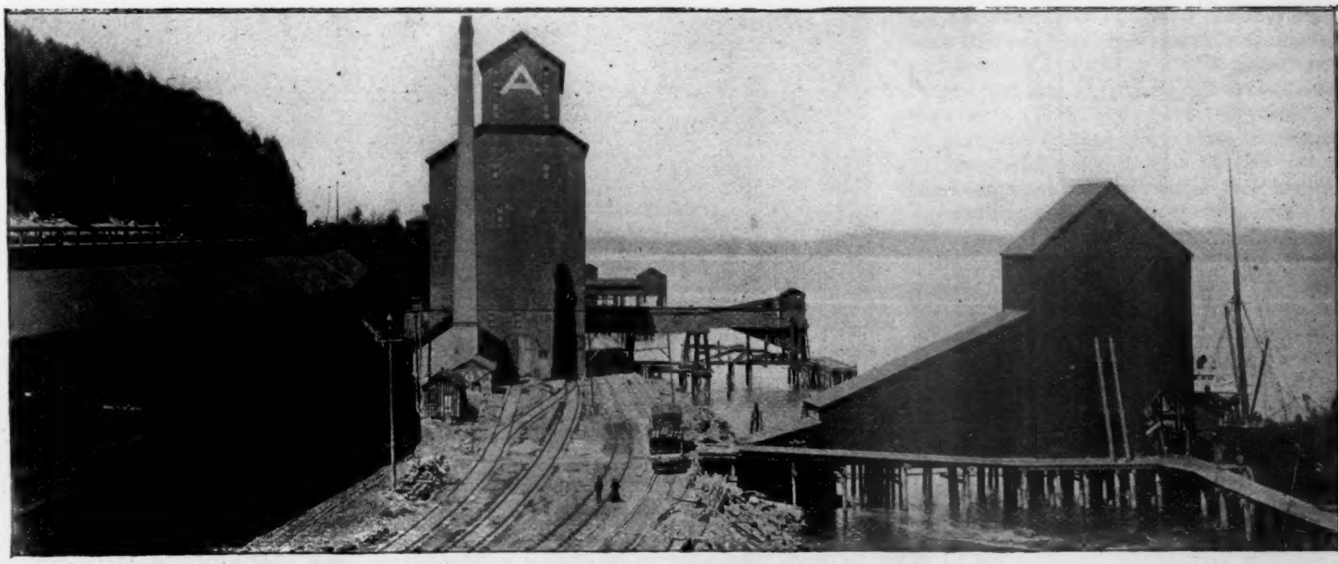
Coal Bunker at Tacoma—Northern Pacific Railway.

The new coal bunkers built by the Northern Pacific Railway at Tacoma, Washington, for the purpose of loading vessels at that port, combine large storage capacity with economy in handling coal and low construction cost for the plant. We acknowledge the courtesy of Mr. E. H. McHenry, Chief Engineer, and Mr. Charles S. Bihler, Division Engineer of the Northern Pacific Railway, for the drawings, photographs and information which form the basis of this description.

Coal bunkers used for the storage of coal to be loaded into vessels have usually been built out into the water, and as it is necessary to provide for vessels of deep draft, the substructure has necessarily been very costly, especially in salt water where timber work is exposed to the attacks of the teredo. An additional difficulty arises on account of tides, the extreme range at the Puget Sound ports being about 20 feet. In order to allow vessels to load at nearly all stages of the tide, a large amount of storage coal must be elevated to a considerable height, and, as a consequence, the cost of coal bunkers constructed on the ordinary plan is considerable per ton of storage capacity.

With the new plant advantage has been taken of the peculiar formation of the shore. From the water's edge the ground rises very abruptly to a height of several hundred feet, the formation being hardpan and cement gravel. On this bluff the foundation for the bunker has been prepared by excavating a slope of the proper angle to make the coal run freely.

The bunker itself consists of a box, with a sloping bottom, which has been set on this slope. The coal is dumped into the bunker from the top, two tracks running its entire length and being connected in such a manner as to make operation as convenient as possible. The engine pushes the loaded coal cars up on the tracks constructed behind the bunkers. They are then allowed to run back over the bunkers by gravity, are unloaded and collected when empty on one of the tracks below the bunkers, whence they are returned to the yards. The coal is taken out at the lower end of the bunkers through gates into conveyors, which run the entire length of the bunkers. There are two conveyors leading to the middle of the bunker, where coal is discharged into the sea conveyor, which runs at right angles under the yard tracks out to deep water. At the outer end of the sea conveyor provision is made for the tides and for the different loading stages of the vessels by a bridge 100 feet long, which is pivoted on one end and can be raised and lowered at the front end. The conveyors consist of a series of pans, four feet wide, two feet long and one foot deep, supported by wheels and running on light rails. They are driven by two electric motors, one 50 horse-power, at the head of the sea conveyor, and one of 20 horse-power, which can be thrown into gear with either of the lateral conveyors. The bridge itself is counterweighted and the raising and lowering is done by power furnished by the motor running the sea conveyor. To run the coal from the front end of the sea conveyor to the hatch of the vessel an extension chute is provided, which can be extended or shortened, raised or lowered by power. Only two men are required to operate the entire bunker. One is stationed at the particular gate of the bunker from which the coal is being taken. He regulates the flow of the coal into the conveyors. The other man is stationed at the front end of the bridge, where he has control of the motors and where a number of levers are arranged by which all the different movements are governed.



General View of Bunker and Chute Tower.

The machinery for the bunker was furnished by the Link-Belt Machinery Company, of Chicago. The specified capacity of